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The Oxford Geographies

PRACTICAL
GEOGRAPHY

BY

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Part I

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PREFACE

PRACTICAL work on the part of pupils is now universally recognized as a necessary part of instruction in Geography. It occupies a prominent place both in the *Regulations for Secondary Schools* and in the *Suggestions for Teachers in Public Elementary Schools* issued by the Board of Education, and the syllabuses and examinations of many educational authorities already require this work.

The educational advance is very considerable and is comparable to that which has taken place in the teaching of natural science. Indeed, now that Geography is regarded as a science this development is inevitable. That the pupils have to take an *active* part in the work, and that thereby both attention and interest are increased, would be sufficient to justify the adoption of practical methods. Moreover the pupils may be led to discover and test for themselves many of the principles of the science.

The chief aim of the present book is to give a wide variety of important geographical facts with exercises based upon them, so that not only the facts may be thoroughly understood and learnt, but the causes and principles underlying them may be brought out by the working of the exercises. A further aim of the book is to accustom the pupils to the intelligent use of statistics, especially those dealing with the conditions and progress of our own and other countries.

The field of Geography is so wide that careful selection

of material and exercises has been necessary. Therefore work that is the concern of other sciences, such as astronomy, physics, geology, and botany, has been omitted. For the same reason this book does not discuss the construction of apparatus, but deals with records obtained by the use of the apparatus and the facts and principles established by these records. No exercise has been inserted unless it bears directly upon some important principle, even though the scope of the book does not include the explicit statement of the principle.

Practical work is only one part, although a necessary part, of instruction in Geography, and the following exercises need to be correlated with descriptive and other work given either orally or from a textbook. Hence this book must be regarded as a supplement and aid to the systematic teaching.

The exercises have been extended as widely over the field of Geography as possible, and may accompany any good modern textbook. With the same object of being generally useful, the exercises relate to work which may be carried on either in town schools or in country schools, but the special work which a few schools may find possible, e. g. those near the seashore, cannot be included for reasons of space.

As a general rule statistics have been taken directly from official sources, but a few have been drawn from the very useful *Survey Gazetteer of the British Isles* by kind permission of the compiler, Mr. J. G. Bartholomew, and some climatic data have been obtained from the *Meteorological Record* and the *Quarterly Journal* of the Royal Meteorological Society.

The writer has to thank the Clarendon Press for permission to use some of the maps from other volumes

of the *Oxford Geographies*, and Mr. Herbertson, the general editor of the series, for valuable suggestions in regard to the preparation of this book and for revising the manuscript.

SUGGESTIONS TO THE TEACHER

1. The exercises are drawn up in connected series, and as far as possible should be taken in the order here given.

2. The worked exercises should be kept for reference, for this is necessary when later exercises are based upon earlier ones and desirable in all cases for revision and comparison.

3. It is not necessary that all the exercises should be done by each pupil.

Some of the series may be divided among several pupils, each doing one exercise, and the results may be brought together for comparison and study by the whole class.

In some of the individual exercises the work may be shared. Particularly in the questions on the home district, the information may be gathered by several members of the class and the results combined into one answer.

4. The two parts of the book will afford ample material for a four years' course, and the exercises for each year may be selected from the various sections of the book. In this case, care must be taken that those which are selected naturally follow one another, and that those which are omitted are not necessary steps in the working of later exercises.

5. Similarly, if the time allowed for Geography is insufficient for the working of all the exercises, care should be taken that the omissions do not cause gaps which destroy the coherence of the course.

6. Some of the exercises, especially those on Sunlight and Temperature, must be done at special times of the year, or when special conditions prevail. In the planning of any course these will have to be inserted at suitable intervals among the exercises of a different character.

7. The work placed under the heading 'Ordnance Survey Maps' in Part I, deals with the geography of a portion of Surrey. From it hints may be obtained as to the further study of any home district by means of the local Ordnance Survey Maps.

8. The 1-inch and 6-inch Ordnance Survey Maps may be obtained at cheap rates for educational purposes. The 'Outline and Hill-Shading' Edition is the more useful of the two editions thus supplied. For detailed particulars, application should be made to *The Director-General, Ordnance Survey, Southampton.*

Note. Part II deals with Map-Making ; Weather Changes and their Causes ; The World as a Globe ; The Principal Countries ; Comparative Developments of Britain and other Countries.

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PRACTICAL GEOGRAPHY

MAPS AND PLANS

Direction

WE may indicate the direction of certain places from the school by saying that they are north, south, east, or west of the school, as the case may be, but if we wish to do this it is necessary first to find out which direction is the north, the south, the east, or the west. The following exercises show how this may be done.

Exercise 1. Place a stick upright in the sunlight and notice that the line made by the shadow at any moment has one end pointing towards the Sun and the other end pointing away from it. Observe positions of the Sun and its shadow at different times of the day.

Exercise 2. Fix the stick in a place where it may remain in the sunlight and undisturbed for a few days. At midday on the first sunny day draw a line on the ground along the shadow and add an arrow head at the end of the stick to point towards the Sun.

Exercise 3. At midday on the next sunny day observe where the Sun is, and repeat this on the next few days at the same hour. What do you conclude about the position of the Sun at midday?

Exercise 4. As this direction does not change it may have a name. We call it the south. Draw a line on the ground pointing to the south and place a large arrow head pointing in the opposite direction—this we call the north. Face the north and stretch out your right arm ;

mark the direction on the ground, taking care that the line is at right angles to the north-south line ; this line points to the east. Again face the north and draw another line towards your left (or continue the last line across the north-south line towards your left) ; this line points to the west. Mark the ends of the lines N., S., E., W.

Exercise 5. Stand at the centre of the four lines and with their aid name objects such as trees and buildings which are to the north, south, east, or west of you.

Exercise 6. The four points which these lines indicate are called the cardinal points. Draw lines between these from the same centre and mark them NE., SE., SW., and NW., according to the cardinal points between which they are drawn. Find objects in these new directions.

Exercise 7. Draw a circle upon a large sheet of paper and two thick lines through the centre at right angles to each other ; mark where the lines cut the circle N., S., E., W. Half-way between these lines draw thin ones to obtain the NE., SE., SW., and NW. points. Half-way between the thin lines draw dotted ones and mark the points where they cut the circle NNE., ENE., ESE., SSE., SSW., WSW., WNW., and NNW.

Exercise 8. The Sun is not always *exactly* in the south at 12 o'clock, and so another method must be used to fasten this Sun-chart exactly in its true position. It is found that when the Sun is in the south, it is highest in the sky and therefore casts the shortest shadow. For half an hour before and after noon mark at short intervals the end of the shadow of a long stick ; join these marks by a curve and find, by careful measurement, which point on the curve is nearest the stick. The line joining this point to the base of the stick is in a

true north-and-south direction. For future reference fasten the Sun-chart with its north-and-south line parallel to this line.

Exercise 9. Other heavenly bodies besides the Sun can be used to discover the cardinal points. Find the group of stars known as the 'Plough' or the 'Great Bear'. Imagine a line joining the two stars called the 'Pointers' (see Fig. 1) and imagine it prolonged till it is about six times its length. This imaginary line will almost touch a fairly bright star known as the Pole Star. Learn readily to identify this star.

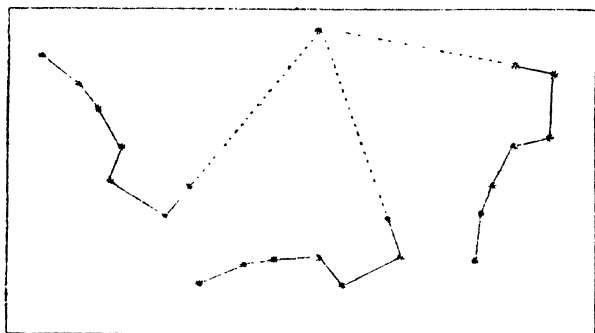


FIG. 1. The Position of the 'Plough' Group of Stars in Relation to the Pole Star, at Intervals of Four Hours.

Exercise 10. Observe the direction of the Pole Star. In what direction is it when you first observe it? Has it changed a few hours later? Next evening? Can it be used to discover the cardinal points?

Exercise 11. It is important for sailors to be able to tell the cardinal points at any moment in order that they may know the direction in which to steer. To enable them to do this when the heavens are covered with cloud they have an instrument called the Mariner's Compass.

Make a simple compass by balancing a magnetic needle upon a pivot and allow the needle to come to rest. In which direction does it point?

Exercise 12. Compare the north and south axis of the needle with the Sun-chart. Do they quite agree? Measure the angle between the compass needle and the true north. This angle is called the 'magnetic declination' or 'variation'.

Exercise 13. Construct another chart similar to the Sun-chart. Measure the magnetic declination west of the true north and draw a short arrow-headed line at this point. You have now constructed a compass card.

Exercise 14. Test this compass card by placing it beneath a magnetic needle and turning it until the short arrow-headed line is directly below the needle. Does the north as indicated by the compass card coincide with north on the Sun-chart? Also compare your needle and compass card with a purchased mariner's compass.

Plans and Scales

Exercise 15. Make a drawing of a cube (or a box in the shape of a cube) so that the top and two of the sides appear. Make a drawing of the same, looking down directly upon it so that none of the sides is visible. Contrast the first drawing with the second, which is called a plan.

Exercise 16. Lay a large thick book flat upon a table and make first a drawing and then a plan of the book in the manner of the preceding exercise. Again contrast the drawing with the plan.

Exercise 17. Set the same book upright and proceed as before. Contrast the plan now produced with that of the preceding exercise. Does a plan alone give a clear idea of the object?

Exercise 18. Draw the plan of a pencil (*a*) in a horizontal position, (*b*) in a vertical position.

Exercise 19. Draw a plan of an inkstand, taking care that you introduce nothing but the portion which you can see when looking directly down upon it.

Exercise 20. Draw the plan of a table with a rectangular top. Does the plan give you any idea of the size of the table? Draw the same plan again but larger, i. e. on a larger scale.

Exercise 21. Measure the table first, and then draw the plan making the side of the plan one inch long for every foot of length in the table itself.

Exercise 22. Fill in the blanks in the following statements about this plan:

'One . . . in the plan represents one . . . in the object.'

'The plan is drawn on a scale of one . . . to one . . .'

'The scale on which the plan is drawn is one inch to . . . inches.'

'The scale on which the plan is drawn is 1 : '

'The scale on which the plan is drawn is $\frac{1}{12}$ ' (a vulgar fraction).

Exercise 23. Draw a plan of the same table making the side of the plan two inches long for every foot of length in the table itself.

Exercise 24. Fill in the blanks in the statements about this plan:

'One inch in the plan represents . . . inches in the object.'

'The plan is drawn on a scale of one inch to . . . inches.'

'The scale on which the plan is drawn is 1 : '

'The scale on which the plan is drawn is $\frac{1}{12}$ ' (a vulgar fraction).

Exercise 25. Draw a plan of a desk on a scale of $1\frac{1}{2}$ inches to 1 foot, and write under the plan:

'Scale 1 to . . . ' and 'Scale $\frac{1}{12}$.'

Exercise 26. Fig. 2 is a plan of a school-room. How does it show (a) the shape, (b) the size, (c) direction?

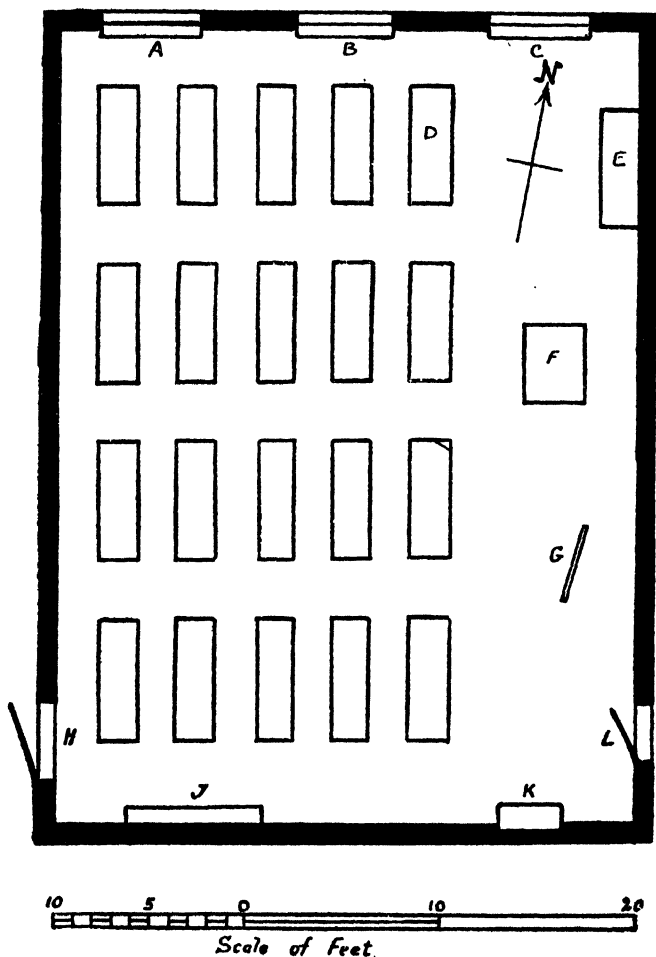


FIG. 2. Plan of School-room.

Exercise 27. The scale of feet is given. Measure it with a ruler and state the scale in the forms:

(a) 1 inch to . . . feet.

(b) 1 inch to . . . inches.

(c) 1 : (d) $\frac{1}{2}$.

Exercise 28. Copy the scale on a piece of paper and measure: (a) the length and breadth of the room, (b) the width of the windows *A*, *B*, and *C*, and of the doorways *L* and *H*, (c) the length of the desk *D*, the cupboard *E*, the table *F*, the fireplace *K*, and the museum *J*.

Exercise 29. What is the area of the room in square feet? How many boys could sit comfortably at each desk? How many boys could the room accommodate? What is the amount of total floor space per boy?

Exercise 30. In which direction do the windows ~~look~~? Is this direction a good one for ordinary school work? Would this room be suitable as a geography room?

Exercise 31. Draw a plan of your own school room in a similar way, but using a scale of 1 inch to 5 feet. Express this scale as a fraction.

Exercise 32. Draw a plan of the school. The plan should be at least 8 inches long; it will be necessary therefore to find the length of the school and divide it by 8, 9, or 10 to obtain the number of feet to be drawn to 1 inch of your plan. Decide upon the scale in this way, measure the school, put the measurements upon a rough sketch-plan, and then draw the plan carefully. Do not forget to show the direction of the cardinal points.

Will you have room to put in the desks, tables, and cupboards? Is it necessary to put in all the details? Is it necessary to put in the windows and doors?

Ordnance Survey Plans

Plans and maps of all parts of the country are prepared by the Government and are known as Ordnance Survey Plans and Maps. Fig. 3 shows a portion of one of the plans on the largest scale, viz. 1 : 500.

Exercise 33. Express the scale of the plan in the forms :

‘One inch to . . . inches.’ ‘One inch to . . . feet.’
 ‘. . . inches to one mile.’

(Give the nearest whole number of feet and inches, and remember that a mile is 5,280 feet.)

Exercise 34. Find the meaning of these symbols marked on the plan: *F. P.*, *L. P.*, *E.* (entrance) *S.*, *S. V*

Exercise 35. Assuming that the plan is on the scale of 1 inch to 42 feet, measure the length and breadth of the portion of the town here shown. Calculate the area in square feet and in square yards.

Exercise 36. What is the length of the church? The width of the houses adjoining? The width of the pavement in front of them? The width of the roadway behind the houses? (Be careful to measure this at right angles to the edge of the pavement.)

Exercise 37. Express the following scales in the form ‘1 to . . .’:

One inch to one mile. Six inches to one mile.

Twenty-five inches to one mile.

One inch to four miles. One inch to ten miles.

Exercise 38. Sometimes the scale is put into a reversed form, i. e. with the length of the object before the length on the plan, as in the following:

Two miles to one inch. Four miles to one inch.

100 miles to one inch.

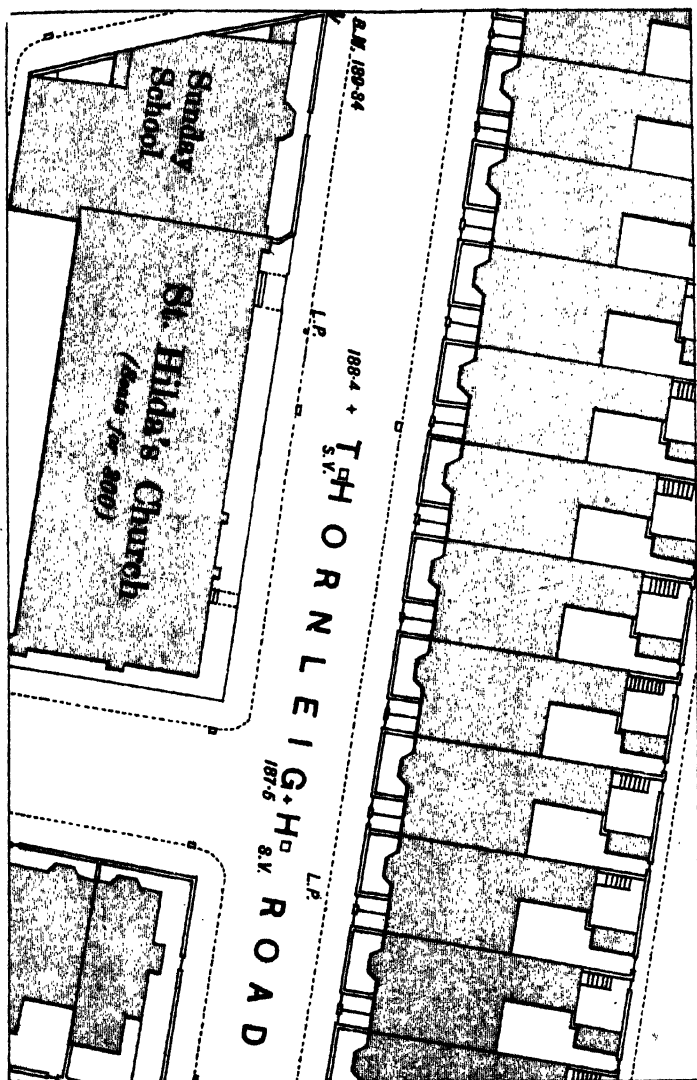


Fig. 3.

Scale 1 : 500.

Reproduced from the Ordnance Survey Map with the sanction of the Controller of H.M. Stationery Office

Put each of these into the first form and express the scales as vulgar fractions.

Exercise 39. Express the following scales in inches (or fractions of an inch) to one mile :—

Scale $\frac{1}{83333}$;

Scale $\frac{1}{126720}$;

Scale $\frac{1}{10550}$;

Scale $\frac{1}{83333}$.

Contour Maps and Sections

The map in Fig. 4 shows the shape and size of an

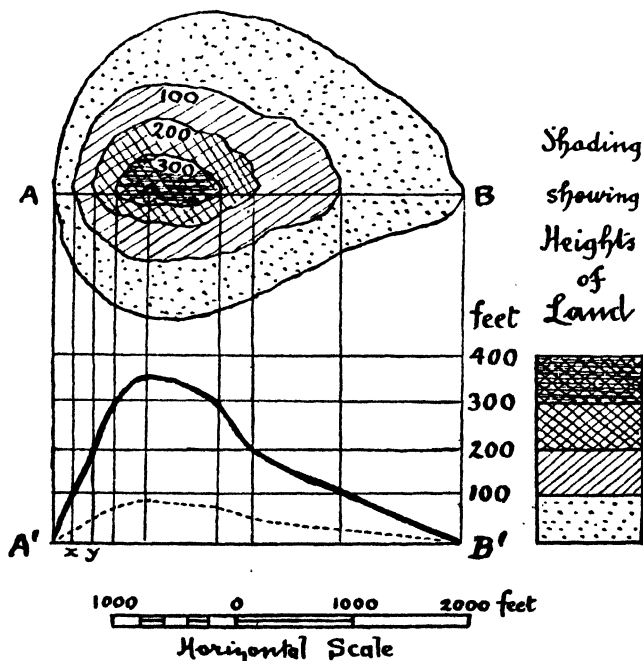


FIG. 4. Simple Contoured Map and Sections.

island, and also the height of the land. The line with

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B

'100' marked within it runs around the island at a height of 100 feet above the sea, and therefore the land between the coast and this line is less than 100 feet high. The line is called the 100-foot contour line.

Similarly the line with '200' marked within it is the 200-foot contour line, and all the land between these two contour lines is between 100 and 200 feet above the sea. Also the 300-foot contour line is shown and the land *within* this contour line is above 300 feet high. The highest point of the island is shown by a small triangular mark; this spot is 350 feet above the sea.

Notice that the figures '100' &c. should always be placed *within* the contour lines and therefore on the ground that is higher than the height the figures represent. This rule is important when several contour lines have to be drawn close together.

Imagine the island cut into two along the line AB through the highest point, and the southern part removed. If the cut edge of the remaining part were looked at, its surface would have a shape similar to the curved line from A' to B' shown below. The lower part of the diagram therefore shows a 'section' through the island along the line AB .

It is drawn by marking off along the straight line $A'B'$, lengths which are equal to the distances between the map contours where AB cuts across them. Such lengths are $A'x$, xy , &c. Next a vertical scale to show heights is drawn above $A'B'$. Then from x a height representing 100 feet by the scale is measured upwards, from y a height of 200 feet, and so on. All the points thus obtained are then joined by a curve and the section is complete.

The length of the piece of ground shown on the map

is usually very much greater than its height and so the heights in the section would be very slight if the same scale were used for both horizontal and vertical distances. Hence the vertical scale is made greater than the horizontal scale. In Fig. 4 the thick line shows the section with the vertical scale much greater than the horizontal scale, and hence both the heights and the steepness of the slopes are much exaggerated. The dotted line below is drawn on a true scale, that is, with a vertical scale equal to the horizontal scale, and therefore the heights and the steepness of the slopes appear much less, but similar to those in nature.

Exercise 40. Copy the horizontal scale from the diagram, and immediately beneath it and parallel to it copy the vertical scale. Compare them, and find out how many times the heights have been exaggerated.

Exercise 41. Set the edge of a piece of paper along the line AB and mark off on the paper the distances on this line between the contours. Transfer these distances to a line $A'B'$ on a sheet of paper. Construct a horizontal scale below $A'B'$, and a vertical scale three times as large upwards from A' and from B' . Draw the section.

Exercise 42. Examine the section and find on which side of the island (east or west) the slopes are steepest. Now examine the map and notice the distances between the contours on the east and on the west sides. What is the distance between the contours where the slope is steep? where it is gradual? State the relation between the closeness of the contours and the steepness of the slopes.

Exercise 43. Trace the map with contours (Fig. 4) by means of tracing paper and colour it according to the following colour scheme :

Above 600 feet	Dark brown—2 washes.
Between 500 and 600 feet	„ „ —1 wash.
„ 400 and 500 „	Light brown—2 washes.
„ 300 and 400 „	„ „ —1 wash.
„ 200 and 300 „	Yellow —1 wash.
„ 100 and 200 „	Light green—1 wash.
Below 100 „	„ „ —2 washes.

[Note. This scheme is to be used later for the contours of the Ordnance Survey Map tracings, and therefore goes beyond the 300-feet height. Always use a thin wash of colour, and notice that a deeper shade may be obtained by going over the area twice. Of course the two washes of light brown should not produce so dark a shade as the one wash of dark brown. If, as frequently happens, the area to receive two washes is enclosed within the area to receive one wash of the same colour, the whole area should be done first with one wash, and when this is dry the second may be put on the inner area only.]

Exercise 44. Draw a north-and-south line on your coloured map through the highest point of the island. Draw a section across the island along this line, with the vertical scale three times the horizontal scale.

Exercise 45. On this new section contrast the steepness of the slopes near the centre with that of the slopes near the shore of the island. Compare the map contours in the centre and near the shores. Does this section bear out the relation you stated above?

Exercise 46. Below this new section draw another to true scale as is done in the diagram. Shade in black the area between the base line $A'B'$ and the curve of the true scale section.

The map in Fig. 5 is drawn in a similar manner to that

in the preceding figure, with the contour lines at the same intervals of 100 feet, but it is more difficult because the ground is more uneven. The triangular marks show where heights have been measured; they are 130 feet and 350 feet respectively.

Exercise 47. The line AB in Fig. 5 represents 2,000

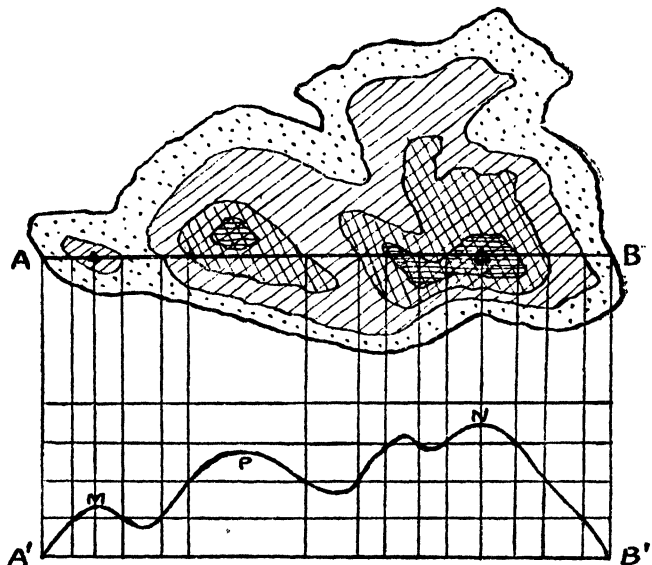


FIG. 5. Contoured Map and Section.

yards. Copy it and from this measurement draw the horizontal scale which is not given in this diagram. Immediately beneath it draw the vertical scale which is necessarily marked in the section with 100-foot intervals. Find how many times the vertical scale is greater than the horizontal scale.

Exercise 48. Trace the map by means of tracing paper, colour it according to the colour scheme suggested

above, and beneath it redraw the section with the vertical scale three times the horizontal scale. By examining the map, find out why the point *P* on the section is put slightly below the 300-foot level.

Exercise 49. Is the relationship you discovered between closeness of contours and slope shown in this map and section? By examining the map, find where the steepest slope is in the island. (It is not along the line *AB*.)

Exercise 50. Draw a section along a north-and-south line through the highest point of the island, with the vertical scale three times the horizontal scale. Beneath draw it again to the true scale and fill in the area of the true scale section in solid black.

Exercise 51. A man wishes to travel from the most southerly to the most northerly point of the island. Find his easiest route, remembering that he will wish to go as directly as possible, but will also avoid climbing.

Exercise 52. Examine the contours on the map, and find a well-marked valley running from almost the highest point of the island down to the sea.

Exercise 53. By placing a ruler on the section in Fig. 5, find which of the places *A'*, *M*, *P*, and *B'* can be seen from the highest point *N*. (Remember that we can see in straight lines only, and that the ground is not transparent.)

Exercise 54. Examine your north-and-south section in a similar way, and find out whether you can see the shore on the north coast and the shore on the south coast from the highest point.

Exercise 55. Fig. 6 shows how contour lines may be drawn when the heights have been obtained. Trace the figures, and without reference to the diagram draw the contour lines at intervals of 10 feet from 40 feet to 90 feet.

When you have drawn the contour lines, compare them with those in the diagram. Note that the 50-foot line will pass through a point midway between points marked 47 and 53, but it will pass through a point which is one-third of the distance from a point marked 47 to a point marked 56, and will pass through a point which is four-

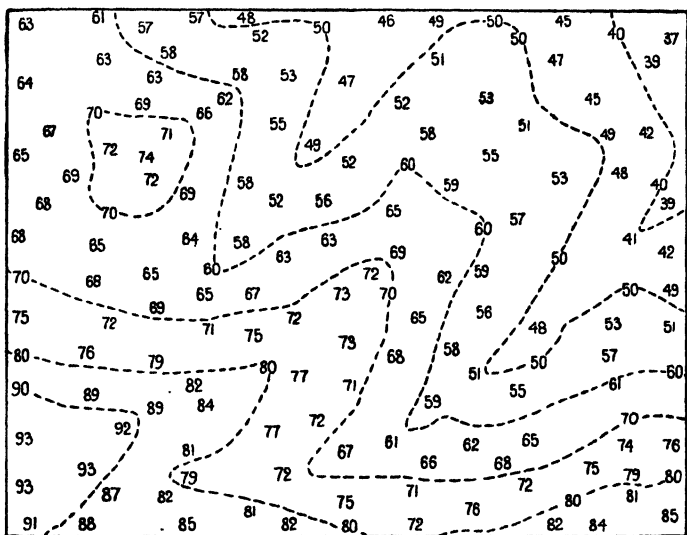


FIG. 6. Map showing Heights with Contours.

fifths of the distance from a point marked 42 to a point marked 52.

Exercise 56. Trace the heights marked in Fig. 7 and draw the contour lines from 20 feet to 60 feet at 10-foot intervals.

Additional exercises may be devised from the maps produced in the last two exercises, e. g.

1. The maps may be coloured on a scheme similar to that suggested above.

2. Sections may be drawn taking into account both the contour lines and the given heights encountered on the section lines.

3. The relief of the land (the position and arrangement of the hills and valleys, and the gentle and steep slopes) may be described in words from an examination of the contour lines.

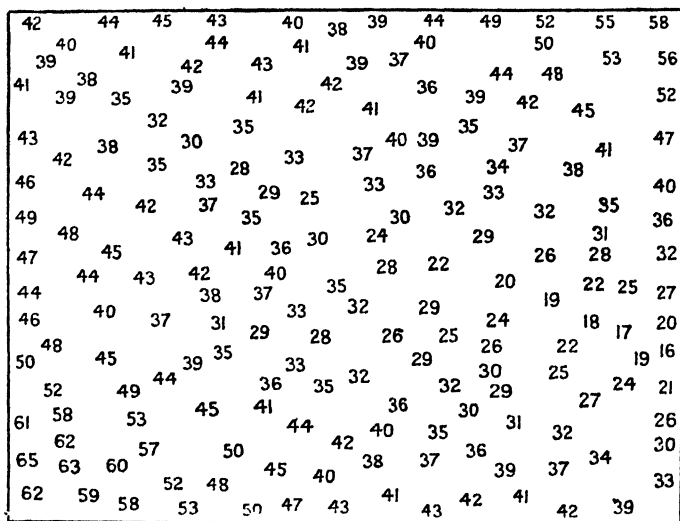


FIG. 7. Map showing Heights without Contours.

Ordnance Survey Maps

Exercise 57. The map in Fig. 8 is on a scale of 25 inches to one mile. How many yards (to the nearest whole number) does one inch on the map represent? Draw a scale very carefully upon tracing paper that you may lay it on the map and measure distances. Make the scale 6 inches long, and divide it into inches and tenths of an inch.

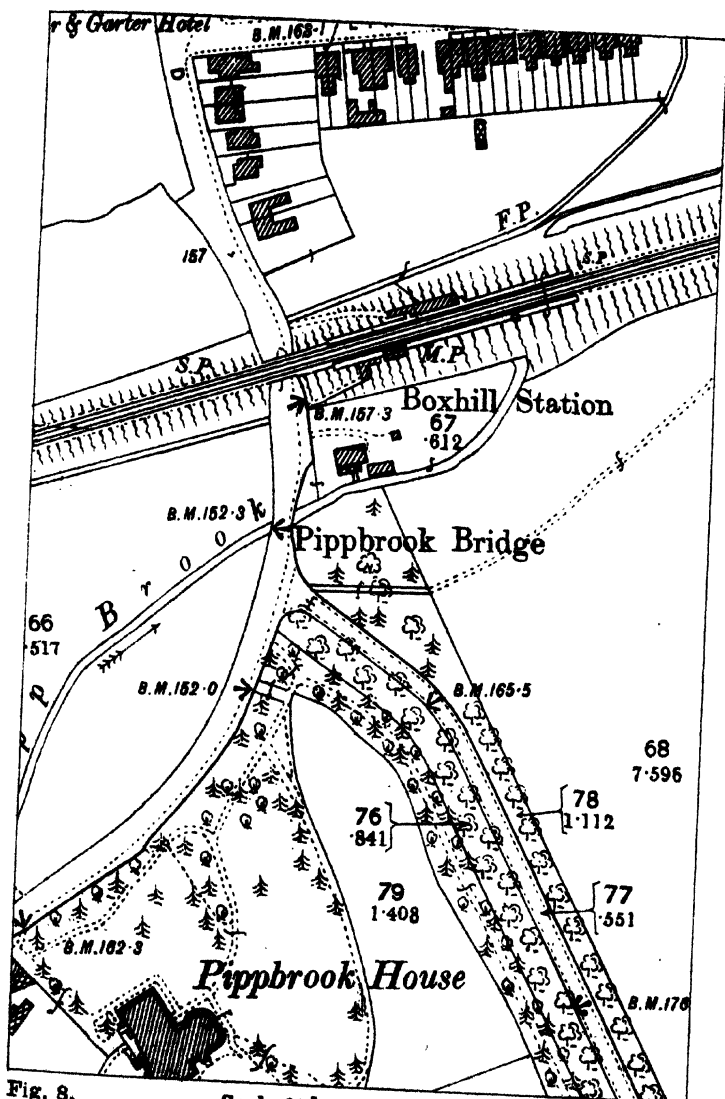


Fig. 8.

Scale 25" to 1 Mile.

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Exercise 58. What is the length and the breadth of the piece of country shown in the map? What is the area in square yards, and in acres? What is the area expressed as a fraction of a square mile?

Exercise 59. The short broad arrows on the map show where a height has been measured and the place marked by a broad arrow cut into a stone or a wall. The mark is called a 'Bench Mark', and the height in feet is indicated by the number after the letters B.M. Notice the arrow on Pippbrook Bridge and explain the symbol 'B.M. 152.3' on the west of the arrow.

[*Note.* The Bench Mark heights are always shown in italic numerals. The larger numerals with thinner ones beneath them show the areas of various pieces of ground. Thus the sign $\begin{smallmatrix} 79 \\ 1.408 \end{smallmatrix}$ above the word 'House' in the south of the map means that that piece of ground is numbered 79 on the list of the Survey of this district and covers an area of 1.408 acres.]

Exercise 60. Which is the highest point shown on the map? What is the distance from this point along the path to Pippbrook Bridge and back again? If you were cycling, would you go more quickly on the northward journey or on the southward return journey?

Exercise 61. The road which crosses the Pipp Brook by Pippbrook Bridge is called the London Road because it is the high road from the town of Dorking (which is just south-west of the area) to London. Does the road go over or under the railway by Box Hill Station?

Exercise 62. The London Road has a height of 157 feet a little way north of the railway (see the map). Could you see where this height had been measured if you went to the place? Notice all the heights and

crossings on the London Road, and describe the ups and downs of a journey along it from the direction of the town of Dorking towards London as far as the map shows the road.

Exercise 63. The grounds around Pippbrook House have both coniferous and deciduous trees. Find what trees are indicated by these terms, and then decide which of the tree symbols on the map stands for each kind.

Exercise 64. Notice the symbols 'S.P.' on the railway on either side of the Box Hill Station. What do they mean? How far is it between them?

Exercise 65. The little wavy lines going out from the railway lines to each side show the slope of the ground from the railway lines to the land on each side. The rule is that the thick part of the little wavy lines is on the higher ground and the thin end goes down to the lower ground. Is the railway here on an embankment or in a cutting? Does this agree with the way the London Road and the railway cross?

Exercise 66. In which direction does the Pipp Brook flow? How is it crossed by (a) the London Road, (b) the railway?

Exercise 67. The map in Fig. 9 is on a scale of 6 inches to 1 mile. Is it on a smaller or a larger scale than the preceding one? How many yards does one inch on this map represent? Draw a scale on tracing paper by which to measure this map.

Exercise 68. What is the length and the breadth of the land shown in this map? What is the area in square yards and in acres? What is the area expressed as a fraction of a square mile?

Exercise 69. Find the area in this 6-inch map that was shown in the 25-inch map.

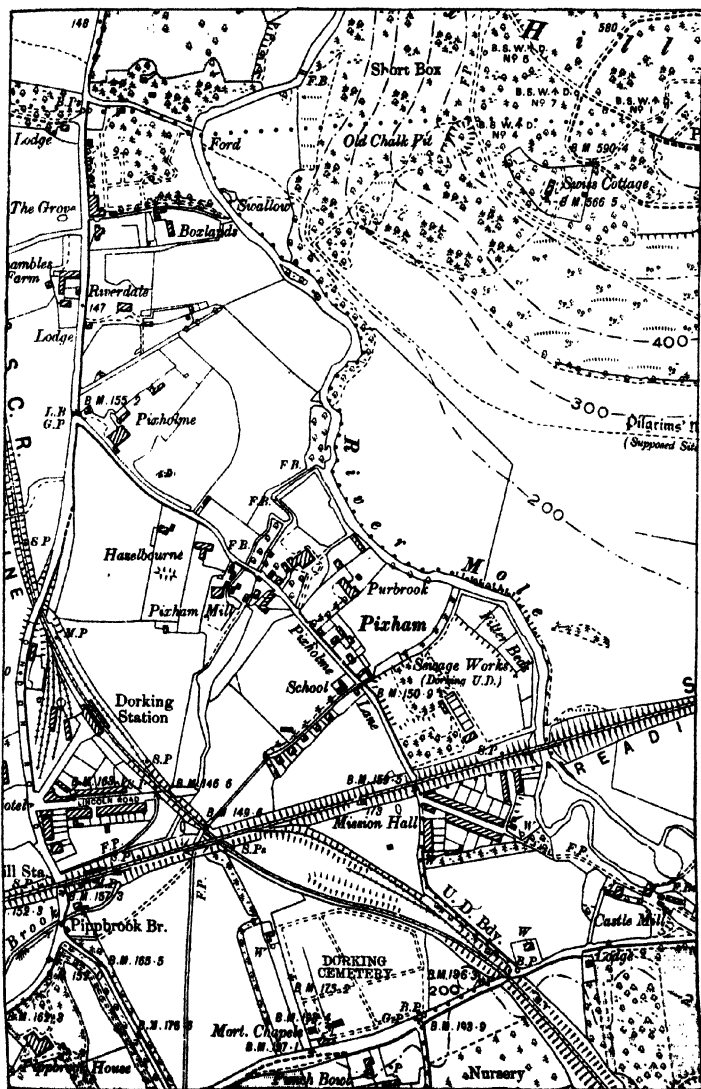


Fig. 9. Scale 6" to 1 Mile.
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Exercise 70. Find the London Road and continue the description of the ups and downs (as in Exercise 62) as far as the 6-inch map shows.

Exercise 71. Into what river does the Pipp Brook flow? What is the meaning of the letters 'F.B.' near the junction of the brook and the river, and also by the river at the northern boundary of the map?

Exercise 72. At how many places and in what ways can the river be crossed in this area?

Exercise 73. Find (a) a railway embankment, (b) a railway cutting, (c) two railway stations.

Exercise 74. Compare the 25-inch and 6-inch maps. What features shown in the former have to be omitted in the latter?

Exercise 75. The hill in the north-east corner is Box Hill. Notice the 200, 300, 400, 500, and 600-feet contour lines. Follow these contour lines along; if necessary, mark over them carefully; then trace these and the river on a sheet of paper. Colour the areas between the contour lines according to the colour scheme given above.

Exercise 76. Draw a section along the northern boundary of the 6-inch map from the point on the London Road marked 148 feet to the point on Box Hill marked 580 feet. Assume that the river is 130 feet above the sea. Make the vertical scale at first three times the horizontal scale, and then draw to the true scale beneath.

Exercise 77. Draw a section from the letter *P* (within the 600-feet contour line) southward along the eastern boundary of the map as far as the letter *S* by the railway. Assume that *P* is at a height of 610 feet, and that *S* is at a height of 170 feet. As before, draw the section at first with the heights and slopes exaggerated threefold and afterwards to the true scale.

Exercise 78. Compare the two sections and observe the slopes on each. Is the western or the southern face of Box Hill the steeper? Examine the map, and picture to yourself the two slopes while you notice where the contours are drawn.

Exercise 79. What is the length and breadth of the piece of country shown in Fig. 10? What is its area in square miles.

Exercise 80. Find on the 1-inch map the area shown on the 6-inch map. What features did the 6-inch map show that are omitted on the smaller scale map?

Exercise 81. Notice the very thin line which indicates the Pipp Brook on the 1-inch map. Compare the width of the Pipp Brook, the railway, and the London Road on the 2½-inch map. Now compare them on the 1-inch map. Why is the width of the railway and the road exaggerated on the 1-inch map, but the brook shown only by a very thin line?

Exercise 82. Measure as accurately as you can the width of the London Road in yards according to the 2½-inch map, and also according to the 1-inch map. How many times is the width of the road exaggerated in the latter?

Exercise 83. The contours in Fig. 11 have been taken from the 1-inch map and drawn again that they may appear clearly. The only other features redrawn are the river and the railway lines. Trace this sketch-map and colour the contours according to the scheme given in a preceding exercise.

Exercise 84. Compare your contoured and coloured map with the 1-inch map which has the slopes shaded by 'hachures'. Remember the rule about the closeness of the contours and the steepness of the slopes, and see how



Fig. 10.

Scale 1" to 1 Mile.

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far the hill-shading of the Ordnance Map helps you to realize the relief of the land.

Exercise 85. Compare the western and the southern slopes of Box Hill as they are shown in the following:—

- (1) The contours of the 6-inch map.
- (2) Your sections drawn from the 6-inch map.
- (3) The contours and colouring of your map on the 1-inch scale.
- (4) The hachures of the 1-inch map.

Picture to yourself what Box Hill looks like, taking into account the trees as shown on the 6-inch map.

Exercise 86. The area above 300 feet (and therefore coloured in some shade of brown on your map) forms part of the North Downs, which here extend in a direction from about WSW. to ENE. The Mole Valley cuts across them almost from south to north. What is the width of the North Downs on the eastern and on the western sides of the map?

Exercise 87. Draw a section through the North Downs along the western boundary of the map in Fig. 11, observing that the south-west corner of the map shows a height of 270 feet. Make the vertical scale 10 times the horizontal scale. Compare the northern and southern slopes of the North Downs. The northern slope is called the 'dip slope', and the southern is called the 'scarp slope'.

Exercise 88. Draw another section through the North Downs along the eastern boundary of the map. Does this section show the same structure for the hill-country as the preceding one? Compare the dip slope with the scarp slope.

Exercise 89. Taking the lower limit of the Downs as 300 feet, express in the form of a vulgar fraction the height as compared with the breadth of the Downs on the

eastern and western sections drawn in the preceding exercises.

Exercise 90. Reckoning the Mole Valley as extending as far as the 200-foot contour line, find the length and the average breadth of the valley in its course through the Downs.

Exercise 91. Draw a section across the Mole Valley from the point *A* to the point *B* in Fig. 11, making the vertical scale 10 times the horizontal scale, and assuming the following heights not indicated by the contours:—

- (1) *A* and *B* are both at a height of 610 feet.
- (2) The railway is at a height of 150 feet.
- (3) The river is at a height of 130 feet. (This is of course the lowest point of the section.)

Exercise 92. Compare the eastern and western slopes of the valley in this section. Is the river near the gentle or the steep slope? North of this point the river swings to the west of the valley; is it near the gentler or the steeper slope in this case? Further north again the river swings to the east of the valley (just north of Mickleham); observe the slopes here. Suggest a relationship between the position of the river and the steepness of the slopes of the valley.

Exercise 93. Why should there be a connexion between a steep slope and the nearness of a river? Apply your explanation to the case of the southern and the western faces of Box Hill.

Exercise 94. What similarity do you observe between the relief of the ground and the course of the railways as shown on the Ordnance Survey Map? Does a railway in this map go over 200 feet at any point? Over 300 feet? Are there any tunnels in this area?

Exercise 95. What town is situated at the south end

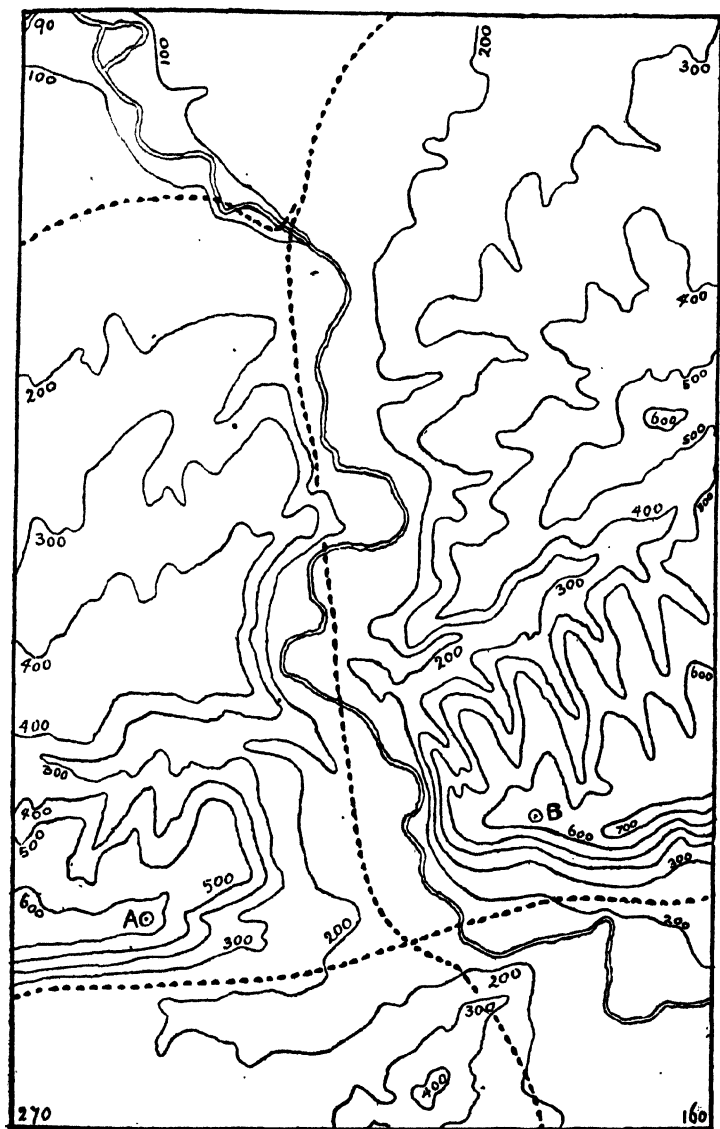


FIG. 11. Contours of the Mole Valley. Scale 1 inch to 1 mile.

of the Mole Valley? What town at the north end? How are these positions suitable for towns?

Exercise 96. Describe the position of the village of Mickleham. Do you think it is likely to grow into a town? Give your reasons.

Exercise 97. Three means of communication pass through the valley. What are they? They are close together at the south end of the valley where they are crossed by the Reading and Reigate Branch of the

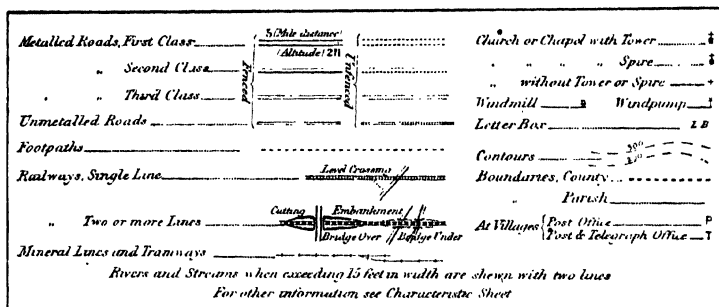


FIG. 12. Symbols used on the 1-inch Ordnance Survey Map.

S. E. and C. Railway. Measure each of them from this point to Leatherhead. Arrange the three means of communication in order of directness.

Exercise 98. Find from your measurements in the preceding exercise in what time each of the following would go through the valley:—

- (1) A train running at twenty miles an hour.
- (2) A cart travelling at six miles an hour.
- (3) A boat going at three miles an hour.

Exercise 99. Learn the symbols used in the Ordnance Map (see Fig. 12), and find examples of each on the 1-inch map.



Fig. 13.

Scale 10 Miles to 1".

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Exercise 100. Unfenced roads command a better view of the country than fenced ones. Bearing this in mind, suggest an eight-mile walk from Dorking and back which gives some good views of scenery.

Exercise 101. Find a good cycling route from Great Bookham to Brockham Church, keeping in mind the following points :

1. It should be as direct as possible.
2. It should avoid unnecessary climbing.
3. It should keep to first class or second class (metalled) roads.

Exercise 102. Figure 13 is a portion of the Ordnance Survey Map upon the scale of 10 miles to 1 inch. Find the length, the breadth, and the area of the country shown in this map.

Exercise 103. Find the Mole River upon the map on the scale of 10 miles to 1 inch. Which features that are shown on the 25-inch map are shown here? Does this map accurately show the way in which the London Road and the railway cross just north of Dorking?

Exercise 104. Compare this map with those upon larger scales. Is the distance (in a straight line) from Dorking to Leatherhead shown accurately on this map? Is the London Road given its correct width? Is the railway given its correct width?

Exercise 105. Examine and describe the course of the River Mole from its source (on the border of Sussex, south of Gatwick Station) to its junction with the Thames. How long is it?

Exercise 106. Examine and describe the shape and course of the North Downs from the western boundary of the map west of Guildford, to the eastern boundary east of Maidstone.

Exercise 107. In the same way examine and describe the much more broken ridge a few miles south of the Downs; including Leith Hill, a lower and therefore more slightly marked ridge south of Reigate and Redhill, Crockham Hill, and the ridge south of Maidstone. How high is Leith Hill? (This line of heights might be called the Greensand Ridge, since it is formed of greensand rock, and therefore quite distinct from the Downs, which are formed of chalk.)

Exercise 108. Describe the relief of the third piece of hill-country, part of which is called Ashdown Forest.

Exercise 109. Describe the course of the River Mole, with reference to these three hilly regions.

Exercise 110. Find the gaps in the North Downs cut by the rivers Wey, Mole, Darent, and Medway.

Exercise 111. Find places near these four rivers whose names seem to be related to the river-names.

Exercise 112. You have already noted the position of Dorking at the south end of the Mole Gap. Find towns in a similar position on the other rivers.

Exercise 113. The southern edge of the North Downs is shown by the hill-shading of the southern or scarp slope. The northern edge may be traced by the railway going from Guildford through Leatherhead, Epsom, Sutton, to Croydon; thence by an imaginary line through Hayes, Orpington, Farningham, Cobham, Chatham, and Newington. Trace out the area of the North Downs, with the rivers and railways crossing them. Where are the Downs widest, and where are they narrowest?

Exercise 114. How many lines of railway cross the North Downs in this area? How many of these take

advantage of river valleys? On which lines are tunnels necessary?

Exercise 115. There is an old river valley, not cut so deeply as those in which rivers now flow, through the Downs from Redhill northward to Croydon. Show how this statement is confirmed by the courses of the roads and the railways, and by the importance of the towns Reigate, Redhill, and Croydon.

Exercise 116. How does the relief of the country explain the convergence of the roads upon Guildford? How many railway lines converge here?

Exercise 117. What connexion is there between the relief of the country and the facts: (1) that a castle is marked near Guildford; (2) that Guildford is the ancient county town of Surrey?

Exercise 118. What advantages had Maidstone as the county town of Kent?

Exercise 119. What advantages have Rochester and Chatham as industrial and commercial centres?

Exercise 120. Contrast the directness of the South-Eastern and Chatham Railway line from Redhill eastward by Tonbridge, with that of the London, Brighton, and South Coast Railway from Horsham to Tunbridge Wells. What reasons are there for this difference?

THE HOME DISTRICT

Heights and Slopes

Exercise 121. Find the height of (*a*) your school-room, (*b*) the school, (*c*) the highest church spire in the neighbourhood, (*d*) the highest hill (its height above the surrounding country). If you obtain the height of the hill from a map, remember that the figure there given is calculated from the sea level, and that it is necessary to subtract from this figure the height of the surrounding country.

Exercise 122. Draw a series of vertical lines from a common base line to show the relative heights just obtained. Use a vertical scale of 1 inch to 50 feet.

Exercise 123. Compare these heights with that of Box Hill above the surrounding country (see Ordnance Maps above). Put the height of Box Hill on the diagram made in the last exercise.

Exercise 124. Draw a series of vertical lines on a scale of 1 inch to 500 feet to show the height above sea level of (*a*) the highest hill in your neighbourhood, (*b*) Box Hill, (*c*) Leith Hill (from Ordnance Map above), (*d*) Snowdon (3,560 feet), (*e*) Ben Nevis (4,400 feet).

Exercise 125. Trace from the local Ordnance Map the contours of any well-marked hills in your neighbourhood. Draw sections through these hills. (The vertical scale will probably have to be multiplied five or ten times unless the hills are very high and steep. The true scale section should be blacked in below.) Compare the slopes as shown by the contours and sections with the slopes as you see them in nature.

Exercise 126. Find some slopes in your district that

are considered steep and need caution in cycling. From the map obtain the vertical height and the horizontal distance of the sloping piece of ground and express these in the form 1 to 8 ; 1 to 12 ; 1 to 16 ; &c.

Exercise 127. Show each of these slopes by means of a diagram in the form of a right-angled triangle with the height of the slope shown by the perpendicular, the horizontal distance by the base, and the slope itself by the hypotenuse. Measure in degrees the angle between the horizontal and the slope in each case. Again, compare the diagram with the slope as seen in nature.

Exercise 128. Obtain some pictures (such as photographs or picture postcards) of the scenery in your neighbourhood. Find each place upon the map. Find the direction in, and the spot from, which the picture is taken, and try to reconstruct the view by looking at the map. Then try to sketch a map of the area from the picture. (The Ordnance Map to be consulted for this purpose should be on as large a scale as possible, i. e. the 25-inch or 6-inch scale, unless the view is of some scenery taken from a distance, and in that case the 1-inch map may be preferable.)

Running Water and its Work

Running water acts in the same way whether it forms a little trickle in the road or a mighty river. You may therefore watch any stream carefully, learn what it has to teach you, and so understand what happens in the case of the greatest rivers in the world. Remember, however, that if the river is much greater than the little stream of water, the *amount* of the work it does is much greater.

Exercise 129. Watch the rain-water running off various surfaces, e.g. a roof, the playground, the road-

way, a field. Answer the following questions in regard to each kind of surface separately :

1. In how many directions does the water flow ?
2. How many main streams of water are formed by the time the water leaves the surface ?
3. Do many tributary streams run into these ?
4. Where are the water partings ?
5. Are the water partings well marked ?
6. Note the basin of each stream that leaves the surface. (Remember that the basin means the whole area from which water drains into the stream.)
7. Compare the size of each basin with the width of the main stream.
8. Which streams run rapidly and which slowly? Why?
9. Which streams most easily wear away the surface as they flow over it? Why?
10. Which streams have the most dirt in them as they leave the surface? Why?

Exercise 130. Watch a stream or river (the larger the better) flowing over some fairly soft earth. Answer the following questions about it :

1. Which way is it flowing ?
2. Why is it flowing that way ?
3. Could you tell the slope of the ground without looking at the stream ?
4. Where does the water come from ?
5. Where does the water go to? (Answer these two questions as fully as you can ; from your observation as far as possible, and then from what you can learn in other ways.)
6. Is the water clear or dirty? If dirty, of what is the 'dirt' composed ?
7. Where has the dirt come from ?

8. What happens to it farther on? (See note to question 5 above.)

9. Measure the largest-sized pebble the stream can move.

10. How fast is the stream flowing? (Put a chip into the water ; observe how long it takes to float 100 yards down the stream ; give the rate in miles per hour.)

Exercise 131. Compare this stream after a dry season and after heavy rains in the following respects :

1. The width and depth of the stream.
2. The condition of the banks (e.g. flooded, worn away, &c.).
3. The rate of the flow.
4. The amount of matter carried along.
5. The size of pebbles the stream can move.

Exercise 132. Find two streams (or possibly two parts of the same stream) which flow at different rates. In each case measure the rate and notice the amount of matter and the size and weight of the pieces carried along.

Exercise 133. Compare the results just obtained with those in the case of the stream after drought and after heavy rains. Suggest a rule about the connexion between the rate of flow on the one hand, and on the other hand the amount of matter and the size and weight of the pieces carried along.

Exercise 134. Examine a number of pebbles from the bed of a large stream and arrange them according to their smoothness. What were the pebbles before they were carried into the water? How have they been rounded? Why are some smoother than others?

Exercise 135. Examine a stream after the flood has gone down and the rate of flow has slackened again. Can you find any things which were carried along in flood

time and are not carried now? Compare your observations with the rule suggested in the last exercise but one.

Exercise 136. Find places where the rate of flow in a stream is checked (possibly by a dam, or where the stream broadens out, or where it enters another stream or a lake). Observe the deposit of material, the amount, and of what kind it is. Account for the facts observed.

Exercise 137. Find a miniature delta where a little stream enters a little lake (very possibly in the drainage at the side of a road); make a sketch of the shape of the little delta and compare it with a map of a great one at the mouth of a river.

Exercise 138. Find a place where a stream has flooded its banks and notice the condition of the surface when the flood has gone down. Find similar evidences of a past flood at other places.

Exercise 139. Find a well-marked curve in the course of a stream. Compare the inner and the outer banks of the curve. Which bank is worn away most? Near which bank is the rate of flow greatest? (Throw in pieces of grass or sticks to ascertain this). Suggest a reason for the one bank being worn away more than the other.

Exercise 140. Find another curve. Repeat the above observations. Suggest a rule connecting the outer bank of a curve with (1) the rate of flow, (2) the amount of cutting, (3) the height of the bank. Test the rule at other curves.

Exercise 141. Make similar observations in regard to the inner bank of curves. Formulate and test a rule connecting the inner bank of a curve with (1) the rate of flow, (2) the amount of wearing and depositing, (3) the height and nature of the bank.

Exercise 142. Measure the width of several curves in the course of a very little stream, i. e. measure the amount of the 'swing' of the stream first to one side and then to the other side of its general direction. Find the average width of the swings, and say how many times this is greater than the width of the stream itself.

Exercise 143. Repeat the observations in regard to a stream of a larger size. If possible do this again for a much larger stream. Is there any fixed ratio or any approach to a fixed ratio between the width of the swing and the width of the stream?

Exercise 144. Find a waterfall on a very small scale. What causes the fall? Draw a section through the fall, in the direction of the flow of the water, and show in this the water and the softer and harder portions of the river bed.

Exercise 145. If possible, find a lock in your neighbourhood. Why is it there? Is there also a weir? Why? Is there a charge for using the lock? Why?

Exercise 146. Examine any ponds or lakes in your district. How do they obtain their water? In what ways does the water leave the ponds?

Exercise 147. Name the places where a stream in your neighbourhood can be crossed. By what means are the crossings effected? In each case say why the crossing is arranged just at that place.

Exercise 148. Make a list of all the uses that are made of the streams in your neighbourhood.

Exercise 149. Make another list of the uses made of streams in other districts, which you have heard or read about, but which are not to be found in your own district.

Exercise 150. Are the streams of your district ever of disadvantage to man? (e. g. as barriers to communi-

cations, destructive in time of flood, &c.) What means do men take to prevent or remedy these disadvantages?

The Soil, Rocks, and Weathering

Exercise 151. Examine the surface soil in a garden or field. What different substances are to be found in it? How did they come there?

Exercise 152. Compare this surface soil with the ground some feet below the surface. Account for the differences.

Exercise 153. Find a deep excavation such as a gravel pit or railway cutting, and find how far down the surface soil extends. Can you see a sudden change from this soil to the underlying rock? (Remember that 'rock' in this sense means any material, firm or loose, of which the ground is composed.)

Exercise 154. Notice railway cuttings made in different materials such as clay, sandstone, or chalk. Which is worn down by rain-water and weathering most quickly? Which the least? (Notice the amount of debris at the bottom of the cutting.)

Exercise 155. Sketch sections across railway cuttings which have been made through different rocks. Which rock has to be cut back farthest into a gentle slope? Which is cut back least so that it forms steep sides close to the lines? Account for the differences.

Exercise 156. Collect specimens of the following rocks, whether they form part of the ground of your district or not, and also specimens of any others you can yourself find: granite, slate, marble, limestone, chalk, shale, clay, sand, gravel, sandstone.

Exercise 157. Examine each of these and describe the characteristics under the following headings: (1)

Constituent materials and structure, (2) Hardness, (3) Kind of fracture, (4) Porosity, (5) Uses.

Exercise 158. Select those which form part of the ground of your neighbourhood, and mark on a sketch-map which districts are formed of each.

Exercise 159. Find examples in each district of how the following characteristics of the rocks show themselves in the geography: (1) Structure (are the particles separated by the action of the streams or the weather? are they separated by man for any purpose?), (2) Hardness (note here also the action both of nature and of man), (3) Porosity (notice whether rain-water sinks in readily or runs over the surface into the ditches and streams), (4) Uses.

Exercise 160. Are the hills in your district formed of different rocks from those of the low lands? Give particulars.

Exercise 161. Examine a number of stones or stone erections, as in buildings and cemeteries, for evidences of weathering. Note and record the following particulars about each: (1) Place, (2) Material of which composed, (3) Amount of exposure or shelter, (4) Date of erection, (5) Amount of weathering (e. g. 'not noticeable,' 'slight,' 'rather great,' 'great,' 'very great indeed').

Exercise 162. Tabulate the examples according to the amount of weathering observed, and account for the relative amounts by considering the material and the time and amount of exposure.

Exercise 163. Collect specimens of any ores you can find or obtain from your own neighbourhood. What are the constituents? How are they separated? For what purposes are they used?

Plant Life

Exercise 164. The 6-inch Ordnance Map of your neighbourhood has all the fields marked separately. Give each field a number, observe the use made of each, and classify these uses under the following headings: (1) Corn crops, (2) Root crops, (3) Grass, (4) Fallow, (5) Other uses. (Extend the records over a few years if possible.)

Exercise 165. Colour the map (or a tracing of it) according to the plant life by means of the following scheme :

Uncultivated land (moors, commons, &c.)—Brown.

Woods and plantations—Blue.

Grass-land and fallow-land—Light Green.

Land with root crops—Dark Green.

Land with corn crops—Yellow.

Exercise 166. Place squared tracing paper over the map thus coloured, and count the number of squares of each colour and also the total number of squares in the whole map. Arrange the classes of land shown by the different colours in order of the number of squares occupied.

Exercise 167. By proportion, find the number of squares of each colour per 100 squares of the total land. This gives the percentages of the total land area devoted to each purpose. State these percentages.

Exercise 168. Where are there heaths, moors, or commons in your neighbourhood? Why are they there? Find out if the soil is unsuitable for the growth of trees or more useful plants? What uses are made of these lands?

Exercise 169. In what situations are the woods?

Find out if the land could be used for crops? For what purposes are the woods used?

Exercise 170. What are the most common trees of your neighbourhood? Are any of the kinds found only in particular places? Can you discover why these trees are restricted to these places, having regard to such matters as the nature of the soil, the presence or absence of water, the sheltered or exposed situation?

Exercise 171. Give instances of men having recently affected the woods either by destroying them, by changing their character, or by adding to them. Find out why they have done these things.

Exercise 172. Give instances of men having recently affected the crop-lands either by ceasing to grow crops upon them, by changing the kind of crops (except in the ordinary rotation), or by adding to them. Give the reasons.

Exercise 173. Consider in a similar way the changes in regard to the land usually devoted to grazing or hay-making.

Exercise 174. Find instances where there have been recent natural growths, e. g. on railway embankments, in disused quarries, or in other places. What plants do you find growing? Whence and how have they come there?

Exercise 175. Find where there are (1) any specially wet pieces of ground, e. g. by low-lying ponds, (2) any specially dry pieces of ground, e. g. on chalky or sandy hill sides. Contrast the plants on these two kinds of soil. What kinds of plants are there on each? How are they suited by their structure to their soil?

Exercise 176. Find where there are specially hard rocky soils and specially soft soils. Contrast and examine the plants as in the preceding exercise.

Exercise 177. What plants are found in the highest parts of your district? How are they suited to their position? Are there any plants found elsewhere near you which would not grow in these high situations?

Exercise 178. If possible find some hill-slopes exposed to cold winds and looking northward away from the sun, and some others sheltered from cold winds and looking southward and so receiving more direct sunshine. Do the plants growing on these show the effect of their situations? In what ways?

Exercise 179. Do plants grow equally well in all parts of gardens? Name some plants that grow well only when they receive much heat, and some others that grow well in cooler spots.

Exercise 180. Have any crops of corn or fruit in your district been spoilt either by too much or too little heat? Give the particulars as accurately as you can obtain them.

Exercise 181. Have any crops been spoilt either by too much or too little rain? Again obtain and give the particulars.

Economic Features

Economic matters are those connected with various ways by which men get their living; for example, the mining, manufacturing, agriculture, and commerce of a district are some of its economic features.

Exercise 182. Answer the following questions about any mines or quarries in your district:

1. What minerals are obtained?
2. From what kind of ground?
3. In what directions do the workings go into the ground, and why?

4. How are the minerals obtained ?
5. Where are they sent ?
6. For what purposes are they used ?
7. Where do the workers live ?

Exercise 183. Answer the following questions about each of the manufacturing industries in your neighbourhood :

1. What articles are produced ?
2. What are the raw materials required ?
3. Whence and by what means and routes do they come ?
4. Does the situation of the works give any facilities for obtaining the raw materials ?
5. What processes do the raw materials undergo ?
6. What materials, implements, &c., are needed for these processes ?
7. Whence and by what means are these obtained ?
8. Does the situation of the works give any facilities for obtaining these ?
9. Where do the workers live ?
10. For what purposes are the manufactured goods used ?
11. Where and by what means are they distributed ?
12. Does the situation of the works give any facilities for selling or distributing the manufactured goods ?
13. Summarize the advantages of the situation of the works.
14. Has this situation any disadvantages ? (Consider the points suggested in questions 4, 8, and 12.)

Exercise 184. Find out where, and for what purpose, any of the following means of obtaining mechanical power (i. e. power for working machines) are employed in your neighbourhood :

1. Wind mills.

2. Water wheels acting directly upon machinery.
3. Water wheels producing an electric current.
4. Steam engines acting directly upon machinery.
5. Steam engines producing an electric current.
6. Gas or oil engines acting directly upon machinery.
7. Gas or oil engines producing an electric current.
8. Human labour.
9. Animal labour.

Exercise 185. Answer the following questions about the agriculture of your district :

1. What crops are grown ?
2. Which of these are considered the most important ?
Why ?
3. Is the district specially noted for any crop ? Why ?
4. Do any crops occupy the same ground every year ?
5. Do any crops occupy the ground in rotation with others ? Why ?
6. What rotations of crops are followed ?
7. For what purposes are the various crops used ?
8. At what places are the crops used ?
9. By what means and routes are they sent away ?
10. What farm animals are kept ?
11. Which are considered the most important ? Why ?
12. Is the district specially noted for any kind ?
Why ?
13. How are the animals fed in summer and in winter ?
14. Do any of them always occupy the same land ?
15. Is any land used alternately for crops and for pastoral purposes ?
16. Which crops are produced on such land ?
17. For what products are the animals valuable ?
18. At what places are the products used ?

19. By what means and routes are they sent away?

20. What proportion of the people living in your district get their living from agriculture?

Exercise 186. Answer the following questions about the commerce of your neighbourhood:

1. At what places in your immediate neighbourhood (e. g. at the meeting-place of two main roads) is the greatest amount of trading carried on?

2. What goods are bought and sold at these places?

3. In regard to each class of goods say by what means (or by what combination of means), such as rail, river, or road, the goods are brought to these centres.

4. Which goods are largely sold to the people who require them for their own uses, and which goods are largely sold to other traders?

5. Are these places in an advantageous position for trading? (Bear in mind the needs and the positions of the customers.)

6. Is your town an important trading centre for the surrounding country?

7. What advantages has it in this respect?

8. What advantages in this respect have you heard that other places possess which your town has not?

9. What important towns are directly connected with your town (1) by railway, (2) by river, (3) by canal?

10. Draw a sketch-map of your part of the country showing the facts you give in the answer to the preceding question.

11. Draw another sketch-map showing the roads going out from your town and the important towns to which they lead.

12. Name any neighbouring towns which are good centres for trade.

13. In what ways does their trade differ from that of your town?

14. What special advantages for trade has your town which they do not possess, and what special advantages have they which your town has not?

15. What is the nearest neighbouring town? How far away is it? How long does it take to reach it (1) by walking, (2) by cycling, (3) by train?

Exercise 187. Make a list of the occupations of the people in your neighbourhood. Arrange them in order of importance. Are any of these remarkably prominent? Name some other districts you have heard about in which the same occupations are very important.

Exercise 188. Make a list of the materials used in walls, houses, and other buildings in your neighbourhood. In regard to each one find out whence it comes and by what means it is transported.

THE WEATHER

Sunlight

(a) Sunrise and Sunset

Exercise 189. At what times does the Sun rise and set to-day? (Observe if at all possible ; if not, find from

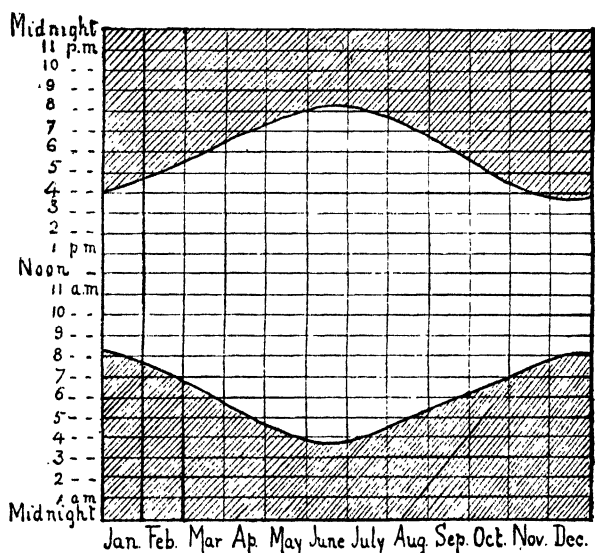


FIG. 14. The Duration of Day and Night at London throughout the Year.

the newspaper or almanac.) What is the duration of the daylight? Does the light or the darkness last the longer? By how much?

Exercise 190. (At successive weeks.) What are the times of sunrise and sunset? What is the duration of

the daylight? Is it increasing or decreasing? At what rate?

Exercise 191. (After midsummer.) When was the day longest? At what hours were sunrise and sunset at that time?

Exercise 192. (After midwinter.) When was the day shortest? At what hours were sunrise and sunset at that time?

Exercise 193. (After the equinoxes.) When were darkness and light equal in duration? How many times in the year does this occur? At what hours are sunrise and sunset at these times?

Exercise 194. (After the above.) Construct a diagram, as in Fig. 14, showing the duration of light and darkness throughout the year, using the facts obtained from the preceding exercises and those given in the following table.

TIMES OF SUNRISE AND SUNSET

<i>Date</i>	<i>A.M.</i>	<i>P.M.</i>
January 1	8.8	3.58
February 1	7.43	4.45
March 1	6.48	5.37
April 1	5.38	6.30
May 1	4.34	7.20
June 1	3.51	8.4
July 1	3.49	8.18
August 1	4.25	7.48
September 1	5.14	6.46
October 1	6.2	5.38
November 1	6.55	4.32
December 1	7.46	3.52

Exercise 195. (At the beginning of November.) Observe exactly at what points of the compass the Sun rises and sets. How many degrees from due east and due west respectively?

Exercise 196. (At the beginning of December.) Repeat the observations of the preceding exercise, and state what changes you find.

Exercise 197. (At midwinter.) Again repeat the observations and state the changes.

Exercise 198. (At the middle of January.) Repeat the observations. Is there a change of a different kind? What do you expect to happen in this matter during the next month?

Exercise 199. (At the middle of February.) Repeat the observations. Have your forecasts been fulfilled?

Exercise 200. How is the position of sunrise connected with the time of sunrise, and how is the position of sunset connected with the time of sunset?

Exercise 201. State why you think this should be so.

Exercise 202. Where does the Sun rise and set at the equinoxes?

Exercise 203. Where does the Sun rise and set at midsummer?

(b) *The Altitude of the Sun*

Exercise 204. Fasten a stick 6 feet high upright in a

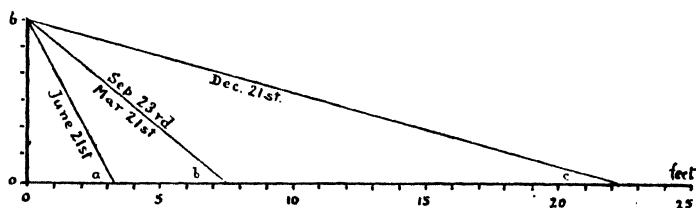


FIG. 15. Altitude of Sun at Midday in Spring, Summer, Autumn, and Winter.

level open space. Note the length of the shadow when the Sun is in the south-east. Fasten a string to the top of

the stick and draw it tightly to the end of the shadow.¹ Observe that the string points to the Sun. Make a large protractor on cardboard and measure the angle which the string makes with the ground, i.e. the height or altitude of the Sun. State the altitude in degrees.

Exercise 205. Repeat the experiment when the Sun is in the following points of the sky: (1) Just past SE. (2) Nearly S. (3) Exactly S. (4) Just past S. (5) Nearly SW. (6) Exactly SW.

Exercise 206. At what point and time is the Sun highest in the sky? What is the altitude of the Sun at noon?

Exercise 207. Draw to a scale of one inch to one foot a diagram showing the height of the stick and the length of the shadow at midday. Test the accuracy by measuring the angle between the string and the ground in your diagram, and comparing with the result previously obtained. Keep the diagram for reference.

Exercise 208. (A month later.) Repeat the experiment, draw a diagram, and compare it with the preceding one. State the change you observe.

Exercise 209. Repeat the experiment at the following times: (1) Midwinter; (2) the Spring Equinox; (3) Midsummer; (4) the Autumnal Equinox. Construct a diagram as in Fig. 15.

Exercise 210. Formulate a rule connecting the mid-day altitude of the Sun and the season of the year.

Exercise 211. Throw the light of a lantern upon a board letting the rays fall at an angle of 62° . Measure the illuminated area. Notice the intensity of the illumination.

Exercise 212. Use the lantern again, letting the rays fall at an angle of 15° . Again measure the illuminated area, and notice the intensity of the light. State the

¹ A vertical knitting-needle in an horizontal-drawing board may be used.

differences you observe between the intensity and direction of light in this and the preceding experiment.

Exercise 213. Fill up the following:

<i>Angle of rays</i>	<i>Area illuminated</i>	<i>Intensity of light</i>
62°		
15°		

Exercise 214. Remembering that heat is given out by the lantern, though it is not so easily measured as the light, fill up this form:

<i>Angle of rays</i>	<i>Area heated</i>	<i>Intensity of heat</i>
62°		
15°		

Exercise 215. Apply the conclusions to the heat given out by the Sun to the Earth when the rays fall at angles of 62° and 15°.

Exercise 216. Fill in the following table

<i>Date</i>	<i>Length of day</i>	<i>Angle of rays</i>	<i>Intensity of heat</i>
Mar. 21			
June 21			
Sept. 23			
Dec. 21			

Exercise 217. Remembering that we must take into account both the intensity of the heat and the length of time for which it is given, state the reason for June being a hot month and December being a cold one.

Exercise 218. State the connexion between the sunshine and the heat of the four seasons, taking the days given in the last exercise but one as typical of these seasons.

Rain

The amount of the rainfall at any place is measured daily by the amount which falls into a vessel known as a rain-gauge. It is in this country measured by the depth to which the rain would amount in the twenty-four hours, expressed in inches and hundredths of an inch. Snow

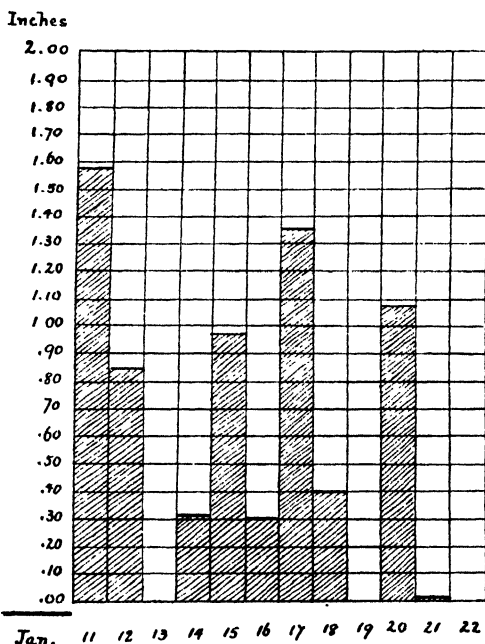


FIG. 16. Chart showing by Shading the Rainfall at Seathwaite, Cumberland, from January 11 to 22, 1906.

can be melted and then measured; a foot of snow is equivalent to about an inch of rain.

The records for a series of days may be plotted as in Fig. 16, the shaded portion representing the depth of the rainfall.

Exercise 219. Read from the chart the amounts of rain at Seathwaite from January 11 to 22, 1906, and put these amounts into the form of a table. What was the total amount for the twelve days? How many days were quite dry?

Exercise 220. The following are the records of rain at London during January, 1906. Construct a rainfall chart as above, and find the total rainfall for the month. Allow a width of $\frac{1}{4}$ inch for each day and a height of $\frac{1}{2}$ inch for every 0.10 inch of rainfall. Notice that the scale is different from that in the rainfall chart for Seathwaite.

RAINFALL AT LONDON, JANUARY, 1906

<i>Date</i>	<i>Inches</i>	<i>Date</i>	<i>Inches</i>	<i>Date</i>	<i>Inches</i>	<i>Date</i>	<i>Inches</i>
Jan. 1		Jan. 9	.08	Jan. 17	.12	Jan. 25	.09
2	.15	10		18	.08	26	.
3	.18	11	.09	19		27	
4	.35	12	.63	20	.09	28	
5	.34	13		21	.03	29	.02
6		14		22		30	
7	.23	15	.06	23		31	
8	.01	16	.41	24	.33	Total...	

Exercise 221. During the twelve months of the year 1905 London had the following rainfall. Construct a rainfall chart for the twelve months, and find the total for the year; allow a width of $\frac{1}{4}$ inch for each month, and a height of 1 inch for each inch of rainfall.

RAINFALL IN INCHES AT LONDON, 1905

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.11	.67	2.77	1.58	.69	4.50	.88	2.17	1.76	.93	2.70	.56

Exercise 222. In which year, 1905 or 1906, did the greater amount of rain fall during January? Can you tell from these two figures what is likely to be the rainfall in London in January?

Exercise 223. What was the average (or mean) January rainfall for the two years? The mean for twenty years was 1.65 inches. By how much did the two-year mean differ from the twenty-year mean?

Exercise 224. Construct a chart showing the monthly rainfall at Durban, Natal, during 1905. Find the total for the year. In which month was the heaviest rainfall? The least? (Scale, $\frac{1}{2}$ inch of height to 1 inch of rainfall.)

RAINFALL IN INCHES AT DURBAN, 1905

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4.44	5.48	4.07	.89	.81	11.12	.71	1.29	2.39	3.87	6.87	3.01

Exercise 225. Construct a chart showing the corresponding conditions during 1904. (Scale as above.) Is the total greater or smaller? In which month is the heaviest rainfall of this year? The least?

RAINFALL IN INCHES AT DURBAN, 1904

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4.11	8.77	4.87	.65	.44	.66	1.89	.18	.58	2.52	3.61	6.44

Exercise 226. Does June appear from the above figures to be a wet or a dry month at Durban? The following table gives the figures for twenty-one years. Find the 21-year mean for June, and then say whether it is a wet or a dry month.

RAINFALL IN JUNE AT DURBAN

<i>Year</i>	<i>Inches</i>	<i>Year</i>	<i>Inches</i>	<i>Year</i>	<i>Inches</i>
1885	.26	1892	—	1899	.17
1886	—	1893	.10	1900	1.04
1887	.74	1894	.58	1901	2.80
1888	.50	1895	.08	1902	.73
1889	.23	1896	.11	1903	.70
1890	.30	1897	3.80	1904	.66
1891	.91	1898	.47	1905	11.12

Exercise 227. Draw a chart on the scale of $\frac{1}{2}$ inch of height to 1 inch of rainfall, showing the mean monthly rainfall at Durban. Describe in words the way in which the rain is distributed through the year.

RAINFALL IN INCHES AT DURBAN
MEAN OF 21 YEARS

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4.35	4.58	4.94	3.16	1.84	.80	.83	1.46	3.76	4.59	4.49	4.54

Exercise 228. Calculate the total annual rainfall in 1904 and 1905, and also the mean annual rainfall. How much was the one year above the mean, and how much was the other year below it?

Wind

The direction of the wind is that from which it comes. It should be observed for a few minutes at a time to get the true direction, and this should be recorded as the nearest of the eight points, N., NE., E., SE., S., SW., W., NW., or as 'calm' if there is no wind to be observed. A chart showing the records of a number of successive days

should be constructed as in Figure 17, and the spaces may be coloured blue or yellow according to whether the day is rainy or dry.

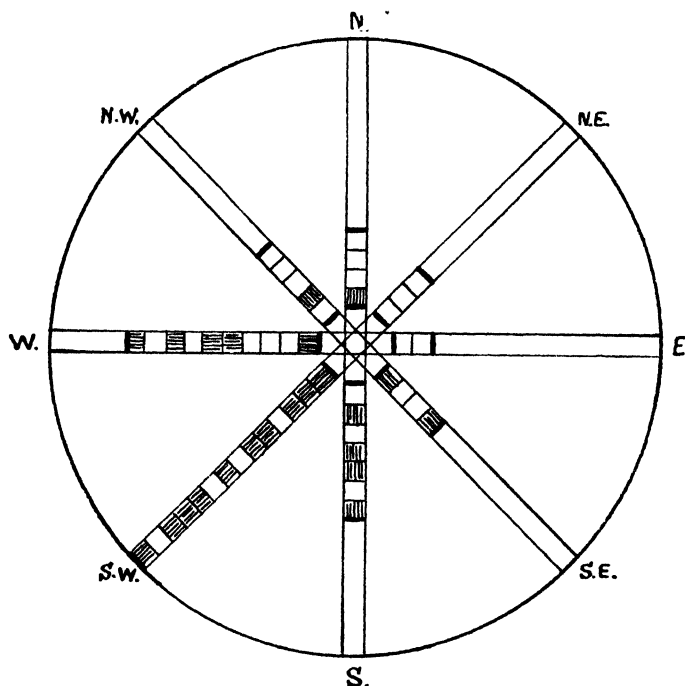


FIG. 17. Wind Chart, showing Rainy and Dry Days.

Exercise 229. Observe, record, and make a chart for the wind of each day for one month.

Make another chart for the next month. Are the winds similar in the two months? If not, how do they differ?

Exercise 230. The following figures give the percentages of the days on which the wind in England blows from each direction in January and July. Draw charts, allowing $\frac{1}{4}$ inch in each direction for 1 per cent.

MEAN DIRECTION OF WIND IN ENGLAND FOR JANUARY AND JULY

Percentage of N.	January	July
NE.	6.3	7.7
E.	6.9	6.1
SE.	7.8	5.1
S.	9.4	5.2
SW.	9.8	9.0
W.	20.9	21.0
NW.	17.4	20.5
Calm	11.4	15.3
	10.1	10.1

Rain and Wind

Exercise 231. Colour each rectangle on the wind chart for your first month blue or yellow according to the presence or absence of rain each day. Is there any connexion between winds of a certain direction and wet days? Treat the second month similarly. Do you see any connexion in this case? If no connexion is apparent, draw a larger chart and on this one put the winds of the two months. Then colour the rectangles going outward from the centre putting all the blue to show the rainy days first (that is, nearer the centre) and the yellow to show the dry days on the outside. Observe and state the direction of the wind which is marked with most rainy days, and of that with least rainy days.

Exercise 232. Compare the charts of your observed winds with those for England. (If your observed month is a winter one, with January; if it is a summer one, with July.) Compare your number of rainy days with those for England. (January, mean number, 17; July, mean number, 14.)

Does the difference between your wind conditions and those for England account for the difference between your rainy days and those for England?

Temperature

The temperature of the air at a place is measured by a thermometer, usually placed in the shade, and in this country it is expressed by degrees on the Fahrenheit scale, on which freezing-point is marked 32° and boiling-point 212° . One form of thermometer has a pen attached which records all the changes during any period (e.g. twenty-four hours), a second form (the maximum thermometer) registers only the highest temperature during the period; a third form (the minimum thermometer) registers only the lowest temperature.

For many purposes the average or mean temperature of a period is required. This may be obtained in several ways, for example, the mean temperature of a day of twenty-four hours may be taken as the average of twenty-four hourly observations, or as the average of the observations at 9 a.m. and 9 p.m., or as the average of the maximum and minimum observations. This last method is commonly used and should be employed in the exercises in this book.

The temperature may be recorded upon a chart in a manner somewhat similar to that in which the rainfall is recorded. As the temperature is continuous and without such breaks as are found in the case of the rainfall, the line marking the temperature is a continuous line going from point to point without a break. It should be noticed, however, that the changes of temperature are not usually so sudden as the changes of direction in the line suggest. Fig. 18 is a chart showing the daily means of temperature for one month.

Exercise 233. Observe the maximum and minimum temperatures each day for a month, calculate the mean temperatures, and make a chart as in Fig. 18.

Exercise 234. Find the average of all these means; this is the mean monthly temperature. Draw a thick horizontal line across the chart at the level of this monthly mean.

Exercise 235. Does the mean of any one day exactly coincide with the mean for the whole month? Which day

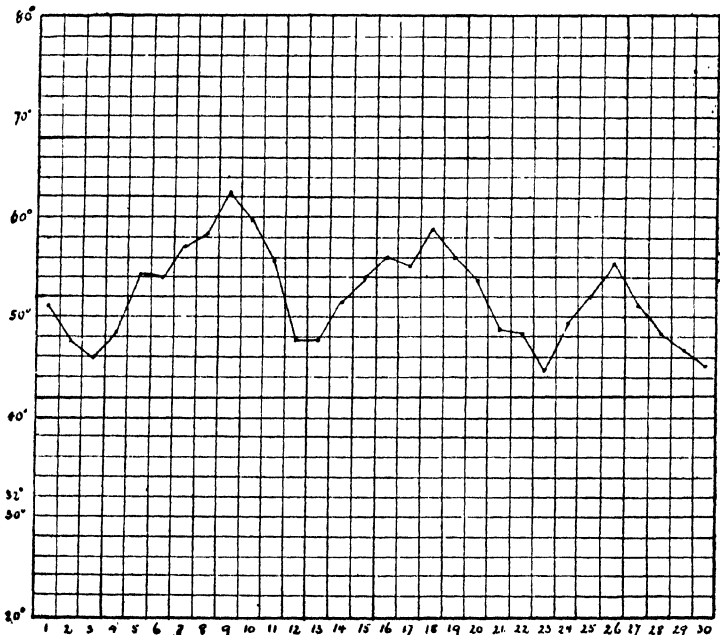


FIG. 18. Chart of Mean Daily Temperatures for one Month.

has the highest temperature? How much is it above the monthly mean? Which day has the lowest temperature? How much is it below the monthly mean?

Exercise 236. At Kew (a suburb of London) the daily means during January, 1907, when averaged gave a

monthly mean of 43.0° . Does this tell you what amount of heat to expect in January at Kew?

Exercise 237. The corresponding monthly mean for January, 1906, was 47.3° , and for January, 1905, was 43.7° . Is this sufficient information on which to give the average monthly mean temperature during January at Kew? Give reasons for your answer.

Exercise 238. After taking the results of observations for twenty-four years, the mean monthly temperature for January at Kew was calculated to be 38.8° . How would you describe the temperatures in 1905, 1906, and 1907 compared with this average?

Exercise 239. The following figures give the mean monthly temperatures at Kew taken over a period of twenty-four years. Plot the records upon a chart.

MEAN MONTHLY TEMPERATURES AT KEW
(*Degrees Fahrenheit*)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
38.8	40.6	42.2	47.7	52.6	59.0	62.9	61.8	57.2	50.2	42.5	40.0

Exercise 240. Which are the hottest and coldest months at Kew? What is the mean annual temperature?

Exercise 241. The difference between the mean of the hottest month and the mean of the coldest month is called the mean annual range of temperature. What is the mean annual range at Kew?

Exercise 242. At Winnipeg, Canada, the hottest and coldest months have mean temperatures of 66° and 7° respectively. What is the mean annual range?

Exercise 243. When the mean annual range is great, say over 40° , the climate is *extreme*; when the mean annual range is slight, say under 30° , the climate is

equable. How would you describe the climates of Kew and Winnipeg?

Exercise 244. Examine Fig. 18, which gives the mean daily temperatures for one month as observed near London. What is the highest temperature? The lowest? The monthly mean?

Exercise 245. Notice how many days there are in the month, and say to which months it is possible that this chart refers. Notice the monthly mean, compare it with the monthly means at Kew, and say to which two of these possible months the chart is most likely to refer.

Exercise 246. Assuming still that the observed temperatures in this month were normal, you have now to decide whether the month was in the spring or in the autumn. In the spring the days on the whole get warmer throughout the month; in the autumn they get cooler. Apply this test and suggest what month is under consideration.

Exercise 247. This method of identifying the month does not decide the matter with certainty. How many possibilities of error does it contain? State them.

Temperature and Altitude

Exercise 248. As one ascends a mountain the temperature falls. At Fort William (beneath Ben Nevis) which is 42 feet above sea-level, the mean annual temperature is 47.2° . On the summit of Ben Nevis, 4,406 feet above sea-level, the mean annual temperature is 31.2° . Find the difference of temperature between the stations, and say to what difference of height this

corresponds. How many feet, on an average, would you have to ascend to observe a difference of 1° in temperature?

Exercise 249. This average would not hold good at all times and places. The following figures refer to the Rocky Mountains of America. Find in this case the number of feet of ascent corresponding to a fall of 1° in temperature.

<i>Place</i>	<i>Altitude</i>	<i>Temperature</i>
Pike's Peak	14,370 feet	19.22°
Colorado Springs	6,004 feet	47.30°

Exercise 250. Is the fall of temperature due to elevation greater or less in this latter case than in the former? By how much?

Exercise 251. The following example is taken from the Alps.

<i>Place</i>	<i>Altitude</i>	<i>Temperature</i>
Col du Géant	11,170 feet	36.50°
Geneva	1,312 feet	70.88°

Find the number of feet corresponding to a fall of 1° in temperature in this case.

Exercise 252. Many other observations have been taken which give slightly different results. Assuming that the above three results are typical, find the *average* number of feet that must be ascended to account for a fall of temperature of 1° .

Exercise 253. The Indian hill-station Simla is about 7,000 feet above the plains beneath it. If the plains have a mean summer temperature of 85° , what is the corresponding temperature at Simla? (Use the average obtained in the preceding exercise.)

Temperature and Wind

Exercise 254. (To be worked in connexion with Exercise 229.) Observe the direction of the wind on each day that you observe the temperature, and record the direction by letters (e. g. W., NW., &c.) above the temperature mark on the chart.

Exercise 255. Take each direction separately and find the average of the mean temperatures associated with it. Do you see any connexion between the temperatures and the directions of the wind on the same days?

Exercise 256. Put the N., NE., and NW. winds into one group and find the average of the temperatures marked under these letters. Similarly put the S., SE., and SW. winds into another group and find the average of the temperatures under these letters. Call the first average the northerly-wind temperature and the second average the southerly-wind temperature. Which is the higher? Suggest the reason.

THE BRITISH ISLES

The Relief of the Land

Exercise 257. Measure the land in Fig. 19, and find the greatest length of England and Wales from north to south and from east to west.

Exercise 258. How far is it across England in a straight line (1) from Bristol to London, (2) from Liverpool to Hull?

Exercise 259. Find the point in England and Wales which is farthest from the sea. How far is the nearest sea from this point? What large town is near this point?

Exercise 260. Measure the total area of England and Wales as given in Fig. 19 by the following method. Draw a square figure each side of which is 100 miles long according to the scale on the map; this figure is therefore 10,000 square miles in area. Place squared tracing paper above it and find how many squares cover it. Put the result into the form: '... squares cover 10,000 square miles.' Now place the tracing paper over the map and count the number of squares which cover the area to be measured. Put the result into the form: 'The area is covered by ... squares.' From these two results calculate the square miles in the area measured.

Exercise 261. Notice the areas in England and Wales over 600 feet high. Describe the arrangement and positions of these uplands.

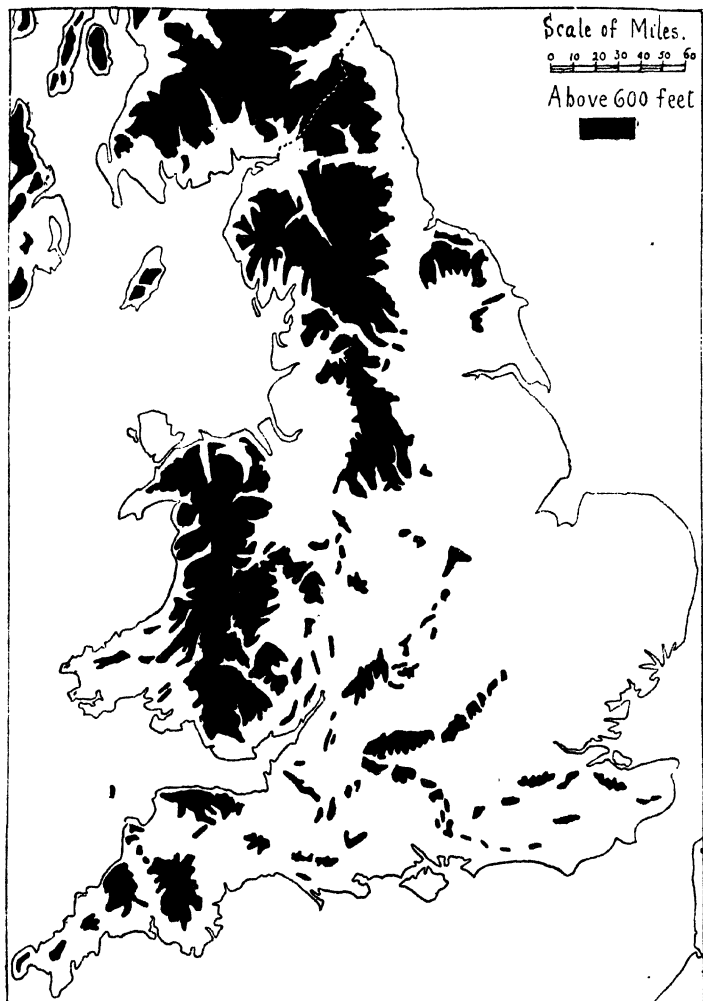


FIG. 19. Uplands and Lowlands of England and Wales.

Exercise 262. Measure the area of the uplands of England and Wales by the method given above.

Exercise 263. Compare the total area with the upland area, and calculate how many square miles on an average would be upland out of 100 square miles of the total area. This gives the percentage of upland area for England and Wales.

Exercise 264. Measure the land in Fig. 20, and find the greatest length of Scotland from north to south and from east to west.

Exercise 265. How does the length of Scotland from north to south compare with that of England? Does it appear on the map to be as great? Why is this?

Exercise 266. How far is it across Scotland in a straight line from the Firth of Clyde to the Firth of Forth? How does this distance compare with the distances across England previously measured?

Exercise 267. Find the total area of Scotland. (Observe that the scale is different from that for England and Wales.)

Exercise 268. Describe the arrangement and position of the upland areas of Scotland.

Exercise 269. Describe the arrangement and position of the lowland areas (i. e. all the areas below 600 feet in height) of Scotland.

Exercise 270. Measure the area of the uplands of Scotland.

Exercise 271. What percentage of the total area of Scotland is upland?

Exercise 272. Measure the land in Fig. 21, and find the greatest length of Ireland from north to south and from east to west. Compare the distance from north to



FIG. 20. Uplands and Lowlands of Scotland.

south with the corresponding distances in Scotland and England.

Exercise 273. How far is it across Ireland in a straight line from Galway Bay to Dublin Bay? How does this compare with the distances across Great Britain already measured?

Exercise 274. Find the total area of Ireland.

Exercise 275. Describe the arrangement and position of the uplands of Ireland.

Exercise 276. Measure the area of the uplands of Ireland.

Exercise 277. What percentage of the total area of Ireland is upland?

Exercise 278. Fill up the following table :

<i>Region</i>	<i>Total Area</i>	<i>Upland Area</i>	<i>Percentage of Upland</i>
England and Wales			
Scotland			
Ireland			

Exercise 279. Which country has the greatest proportion of upland? What effects do you think a large proportion of upland will have upon the country?

Exercise 280. Which of the three regions is most cut up by arms of the sea? Is this an advantage or disadvantage? Give reasons.

Exercise 281. Describe how a railway could best go from town to town given below without crossing upland country :—

(1) London to Carlisle, (2) Hull to Carlisle, (3) Newcastle to Glasgow, (4) Glasgow to Inverness, (5) Edinburgh to Aberdeen, (6) Belfast to Londonderry, (7) Dublin to Waterford.

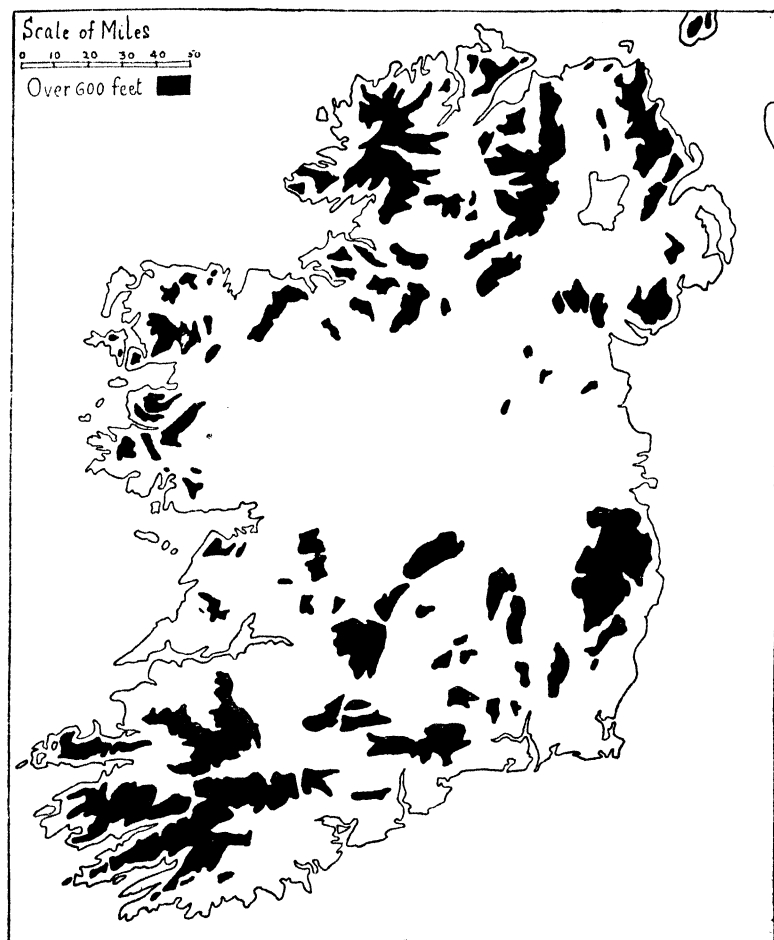


FIG. 21. Uplands and Lowlands of Ireland.

Temperature

MEAN MONTHLY TEMPERATURES FOR JANUARY

Degrees Fahrenheit

Southend 38	Loch Derg 40
Bedford 38	Kildare 40
Leicester 38	Trim... .. 40
Sheffield 38	Newry 40
Ripon 38	Belfast 40
Bridlington 38	
St. Andrews 38	Mid-Dorset 41
Stirling 38	Swansea 41
North end of Loch Erich ... 38	Dolgelly 41
Buchan Ness 38	
Dover 39	Dublin 41
Aldershot 39	Carlow 41
Kidderminster 39	Kilkenny 41
Crewe 39	Limerick 41
Manchester 39	Mouth of River Erne ... 41
Kendal 39	Loch Swilly 41
Keswick 39	Islay... .. 41
Dumbarton 39	Mull 41
Fort William 39	Stornaway 41
North end of Loch Shin... .. 39	
Wick... .. 39	Exeter 42
Cowes 40	Cardigan 42
Bristol 40	Carnarvon 42
Merthyr Tydfil... .. 40	Holyhead... .. 42
Welshpool 40	Carnsore Point... .. 42
Denbigh 40	Fermoy 42
Point half-way from St. Bees	Galway 42
Head to Isle of Man 40	Sligo... .. 42
Wigtown 40	Coll 42
Oban... .. 40	South of Lewis-Harris ... 42
Loch Broom 40	
Cape Wrath 40	Plymouth... .. 43
Duncansby Head 40	Pembroke... .. 43
Londonderry 40	Youghal 43
Lower Loch Erne 40	Cork... .. 43
Loch Allen 40	Tralee 43
	Falmouth... .. 44
	Bandon 44
	Kenmare 44

Exercise 282. The above figures show the mean temperatures as actually observed at the places and then raised to the sea-level temperature. They have been arranged in such a way that the places can be easily found

and the figures entered upon a map. Put the figures upon a large blank map at the places to which they refer.

It is very difficult to understand and to remember the arrangement of these temperatures on the map, and to make it easier lines are drawn connecting places with the same temperature; these lines are called isotherms. (See Figs. 22 and 23.) Places between the isotherms have temperatures between those shown by the isotherms.

Exercise 283. Connect the places by isotherms proceeding as follows: Draw a 38° isotherm from South-end through the places named in the list as far as Bridlington; draw another 38° isotherm from St. Andrews round to Buchan Ness; a 39° isotherm from Dover to Wick; a 40° isotherm from Cowes to Duncansby Head; another 40° isotherm (roughly in the form of an oval) from Londonderry to Belfast and turning to the north-west back to Londonderry; a 41° isotherm from Mid-Dorset to Dolgelly; another 41° isotherm from Dublin to Stornaway; join these two by a curve passing just around the north of the Isle of Man; a 42° isotherm from Exeter through Holyhead, and then turning to the south-west in a great curve through Carnsore Point and the west of Ireland to the south of the island of Lewis-Harris; a 43° isotherm from Plymouth to Tralee; a 44° isotherm from Falmouth to Kenmare. (Draw curves avoiding angles. See Fig. 22.)

Exercise 284. What is the mean temperature in January at the following places not mentioned in the list above: Norwich, London, Birmingham, Hereford, Isle of Man, Land's End, the Orkney Islands?

Exercise 285. Colour the map according to the following scheme, using a *thin* wash or shading *lightly* with crayons: Under 38° a medium dark blue; between 38° and 40° a pale blue; between 40° and 42° a pale

green; over 42° a medium dark green. (Obtain the darker shades by two washes of the lighter ones.)

Exercise 286. Where are (1) the lowest (2) the highest temperatures? Account for this distribution.

Exercise 287. How many degrees' difference is there between (1) the east of England and the west of Ireland in the same latitude; (2) the north of Scotland and the south of England? Is the north-and-south difference greater or less than the east-and-west difference? Why is this?

Exercise 288. The isotherms bend northwards over the Irish Sea. What does this show regarding the temperature of that region as compared with the countries on either side? Account for this.

Exercise 289. There are two large areas of the British Isles enclosed within the 38° isotherm; the southern one includes the Fenland region and the northern one the Eastern Highlands. If you visited these two regions would you expect to find the same temperature?

Exercise 290. Snowdon is 3,560 feet high. Using the rule obtained in Exercise 252, calculate the mean temperature at the top of the mountain in January.

MEAN MONTHLY TEMPERATURE FOR JULY

Degrees Fahrenheit

London	64	Radnor	62
NE. portion of Surrey	64	NE. point of county of Carmarthen	62
NW. portion of Kent	64	Cardiff	62
Gravesend	63	Mouth of River Parrett	62
Cambridge	63	Tavistock	62
Oxford	63	Exeter	62
Winchester	63	Cowes	62
Tunbridge Wells	63	Lewes	62
Ipswich	62	Canterbury	62
Boston	62	Yarmouth	61
Nottingham	62	Doncaster	61
Wolverhampton	62	Chester	61

MEAN MONTHLY TEMPERATURE FOR JULY (*continued*)*Degrees Fahrenheit*

Plynlimmon	61	Sligo... ..	59
Llanelly	61	Aran Islands	59
Lundy Island	61		
Bridlington	60	Aberdeen	58
Darlington	60	Middle point of county of Banff	58
NW. point of Westmorland ...	60	Loch Erich	58
Barrow	60	Greenock	58
Carnarvon	60	Ayr	58
Cardigan	60	Port Patrick	58
SW. point of county of Carmarthen	60	Larne	58
		Moville	58
		North Aran Island	58
		Erris Head	58
Dublin	60	Kinnairds Head	57
Cavan	60	Cromarty Firth	57
Head of Galway Bay	60	Most northerly point of Argyll	57
Limerick	60	Most westerly point of Loch	
Fermoy	60	Fyne	57
		South point of Islay	57
North Shields	59	Wick... ..	56
Middle point of Northumberland	59	Loch Broom	56
Carlisle	59	Rum Island	56
St. Bees Head	59	Coll Island	56
Downpatrick	59	Duncansby Head	55
Belfast	59	A point slightly north-west of	
Strabane	59	Cape Wrath	55
		SW. point of Lewis	55

Exercise 291. As before, the figures represent the mean temperatures as observed, and then raised to the sea-level temperature. Put them upon a blank map.

Exercise 292. Connect the places by isotherms noting the following points: the 64° isotherm encloses a small oval area lying just south of London; the 63° isotherm encloses a larger area extending from Cambridge-shire in the north to Sussex in the south; the 62° isotherm encloses nearly the whole of the south of England with a long tongue running from Somerset and Dorset south-west through central Devon as far as Tavistock which it just

reaches; the 61° isotherm curves north-westward from Yarmouth and then south-westward to Lundy Island; the 60° isotherm curves somewhat similarly from Bridlington Bay to the south-west point of Carmarthenshire, then it runs some little distance out to sea and turns westward and northward up the St. George's Channel to Dublin; in Ireland it includes all the south-eastern part in a wide sweep; the 59° isotherm forms a curve bending north-

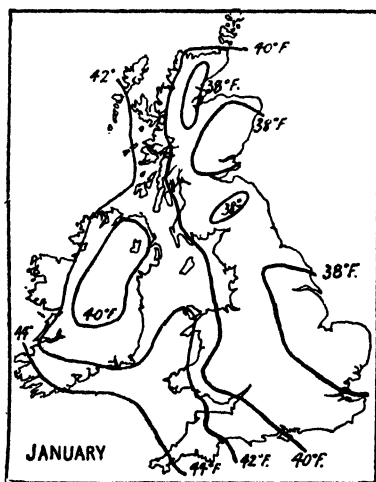


Fig. 22. Mean Temperature of British Isles in January.

wards in the English portion from North Shields to St. Bees Head; thence it runs to the south-west and across the Irish Sea forming a long tongue pointing SSW., and having its southern extremity between Wicklow and Carnarvon; from that point the isotherm runs northward to Downpatrick and then forms another curve bending northward over Ireland; the 58° isotherm has also three portions—first a curve bending northward, then one

bending southward and finally one bending northward ; the 57° isotherm bends in a similar way to the preceding one as far as it goes ; the 56° and 55° isotherms have a general south-westerly trend. (See Fig. 23.)

Exercise 293. What is the mean (sea-level) temperature in July at the following places: Dover, Birmingham, Land's End, Isle of Man, Waterford, St. Andrews, the Orkney Islands?

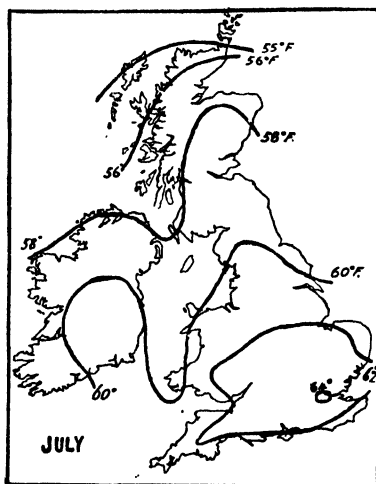


Fig. 23. Mean Temperature of British Isles in July.

Exercise 294. Colour the map lightly according to the following scheme: Over 60° a medium dark red ; between 58° and 60° a pale red ; between 56° and 58° a pale yellow ; under 56° a medium dark yellow.

Exercise 295. Where are the lowest and the highest temperatures in July? Account for their distribution.

Exercise 296. How many degrees' difference is there in July between (1) the east of England and the west of

Ireland in the same latitude ; (2) the north of Scotland and the south of England ? Is the north-and-south difference greater or less than the east-and-west difference ? Why is this ?

Exercise 297. Compare the results of this exercise just obtained with those of Exercise 287 dealing with the differences of temperature in January.

Exercise 298. The isotherms bend southwards over the Irish Sea. What does this show regarding the temperature of that region as compared with the countries on either side ? Account for this.

Exercise 299. Plynlimmon is about 2,400 feet high. What are the mean temperatures on top of the mountain in January and in July ?

Exercise 300. Find the mean annual range of temperature at the following places : London, Bridlington Bay, Birmingham, Cowes, Land's End, Cardigan, Fermoy, Dublin, Belfast, Sligo, St. Andrews, Buchan Ness, Duncansby Head, South of Lewis-Harris.

Exercise 301. Arrange these places in order, from those with the most equable climate to those with the least equable climate. Describe in words where the more equable and the more extreme types of climate are found.

Exercise 302. Account for the difference between the north-west and the south-east of the British Isles in this respect.

Exercise 303. The term 'insular' is sometimes used for 'equable' in regard to climate, and 'continental' is sometimes used for 'extreme'. Would these terms be suitable in the case of the British Isles ? Give reasons for your answer.

Rainfall

This map has been constructed in the following manner. Observations of rainfall were taken daily at many stations throughout the British Isles. The daily readings of the

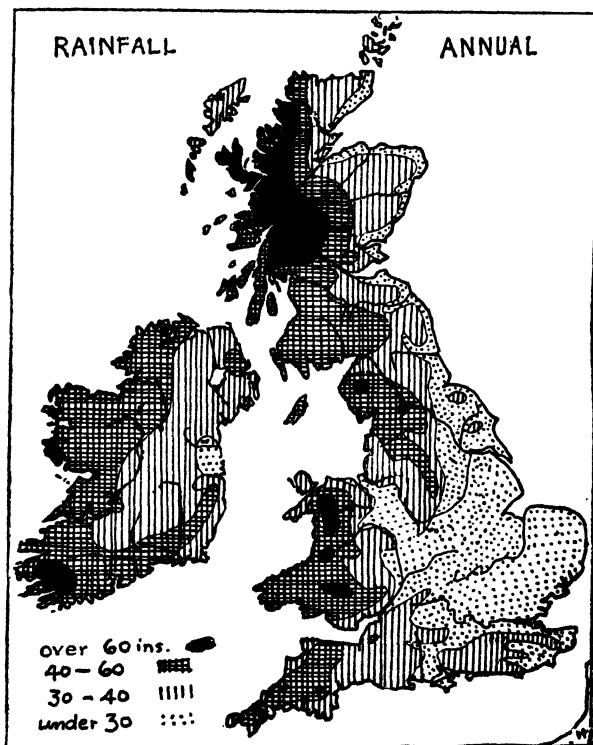


FIG. 24. Mean Annual Rainfall of British Isles.

rain-gauge at each station were added for the total of each month and each year. After a number of years the mean annual rainfall at each station was calculated, and these were entered upon a map. Lines were then drawn

through all places having certain amounts, e. g. 30 inches, similar to the isotherms in the temperature maps. Finally, the shading was added.

Exercise 304. What does the map tell you of the mean annual rainfall at the following places: London, Liverpool, Plymouth, Pembroke, Aberdeen, Skye, Dublin, Londonderry, Killarney?

Exercise 305. Describe in words the distribution of rainfall over the British Isles.

Exercise 306. Adduce from the map reasons for believing that the heavier rainfall is due largely to: (1) the position of the highland masses; (2) the fact that the prevailing wind comes from the south-west.

Exercise 307. Construct a diagram showing the annual rainfall at the following places. Arrange the places from left to right in the order given below, as the successive days are arranged in Fig. 16. Make the width of the diagram $\frac{1}{2}$ inch for each place, and use a scale of 1 inch in height for every 10 inches of rainfall.

MEAN ANNUAL RAINFALL IN INCHES

Carmarthen	Swansca	Oxford	Reading	Greenwich	Shoeburyness
48.65	42.16	24.78	24.55	23.16	18.70

Note. The bottom line of the diagrams should always be the *true* base line, i. e. the line for no rainfall. For example, if the diagram of the preceding exercise were drawn with the lowest line marked 18 inches, Shoeburyness would appear to have practically no rain compared with Carmarthen, for the shaded portion would then fill a space representing .70 and 30.65 inches for the places respectively. This would give to the eye the impression that Carmarthen had many times as much rain as

Shoeburyness, whereas in fact it has less than three times as much. The true relation is brought out by the shading only when the shaded portion for each place starts from the line of no rainfall.

Exercise 308. Redraw the above diagram, making the lowest line the line showing 18 inches. State the various wrong ideas that this diagram would give, and explain the reason for these wrong impressions.

Exercise 309. Note the position of these places in the map. What inference do you draw from the accurately shaded diagram? What facts does it give beyond those given in the rainfall map?

Exercise 310. Compare the rainfall during the days January 11 to 22, 1906, at Seathwaite and at London. (For the amounts see above Fig. 16 and Exercise 220.) State the differences and suggest explanations for them.

Exercise 311. Draw rainfall charts for Sligo and Dublin, allowing $\frac{1}{4}$ inch width for each month and 1 inch of height for each inch of rainfall. Draw the diagrams side by side that they may be easily compared, and calculate the mean annual rainfall at each place. What differences do you observe between the rainfalls of these two places? How can you account for the differences?

MEAN MONTHLY RAINFALL IN INCHES

	Jan.	Feb.	Mar.	Apr.	May	June
Sligo ...	3.8	3.0	2.5	2.0	2.6	2.8
Dublin...	2.1	2.2	2.1	2.1	2.1	1.6
	July	Aug.	Sept.	Oct.	Nov.	Dec.
Sligo ...	3.7	3.8	4.0	4.2	4.7	3.9
Dublin...	2.3	2.7	2.0	2.7	2.9	2.0

Exercise 312. Deal similarly with the mean rainfall at Bolton and Leeds.

MEAN MONTHLY RAINFALL IN INCHES

	Jan.	Feb.	Mar.	Apr.	May	June
Bolton ...	4.0	3.4	3.1	2.3	2.4	3.3
Leeds ..	2.0	1.8	1.8	1.9	1.8	2.1

	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bolton ...	4.2	4.4	5.3	5.5	4.6	4.7
Leeds ...	2.6	2.4	3.0	2.8	2.3	2.7

Exercise 313. Compare the mean annual difference between Sligo and Dublin with the mean annual difference between Bolton and Leeds. Bearing in mind the prevailing wind and the relief of the land which difference would you expect to be the greater?

Exercise 314. The following figures give the mean rainfall over a period of twenty years for England and Wales generally. As the records of a large number of stations have been averaged, the results should do away with special local differences and present a true idea of the way in which the rainfall is distributed throughout the months of the year. Draw a chart to show this, and state in words the chief facts which it indicates.

MEAN MONTHLY RAINFALL IN INCHES. AVERAGE FOR ENGLAND AND WALES

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
2.66	2.27	2.33	1.89	2.05	2.13	2.71	2.90	2.64	3.66	3.38	3.25

MEAN NUMBER OF RAINY DAYS. AVERAGE FOR
ENGLAND AND WALES

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
17	14	15	13	13	12	14	15	14	17	18	18

MEAN AMOUNT OF RAIN IN INCHES RECEIVED IN A
'RAINY DAY'

[illegible]

Agriculture

STATISTICS SHOWING AGRICULTURAL CONDITIONS IN 1913
ENGLAND

<i>County</i>	<i>Total Area</i>	<i>Cultivated land (not including Permanent Pasture)</i>	<i>Wheat Land</i>	<i>Permanent Pasture Land</i>	<i>Number of Sheep</i>	<i>Number of Cattle</i>
Bedford	302	479	125	365	230	111
Berks	461	383	80	375	281	109
Buckingham	477	275	67	553	343	167
Cambridge	551	679	180	212	244	93
Cheshire	648	297	29	523	124	278
Cornwall	856	367	22	339	411	255
Cumberland	962	196	1	381	611	169
Derby	646	126	22	626	200	217
Devon	1667	292	25	435	478	179
Dorset	624	260	32	505	469	151
Durham	646	219	11	444	354	104
Essex	976	518	130	292	189	94
Gloucester	803	282	56	532	364	161
Hants	1049	373	57	273	280	87
Hereford	536	235	39	601	567	191
Hertford	493	496	141	312	181	103
Huntingdon	233	521	142	376	288	120
Kent	973	304	49	449	888	90
Lancashire	1183	200	25	466	267	194
Leicester	531	184	38	708	523	276
Lincoln	1701	586	93	309	551	143
London	74	30	1	64	29	39
Middlesex	147	166	17	436	97	105
Monmouth	348	93	15	587	592	140
Norfolk	1308	595	92	220	307	105
Northants	636	293	68	589	552	215
Northumberland	1284	141	3	404	848	104
Notts	537	406	63	413	323	159
Oxford	477	420	82	442	387	139
Rutland	97	329	40	566	821	203
Salop	857	265	31	571	522	229
Somerset	1035	159	26	661	388	229
Staffs	735	208	30	599	258	226
Suffolk	945	595	117	207	306	78
Surrey	459	213	35	350	103	93

ENGLAND (*continued*)

<i>County</i>	<i>Total Area</i>	<i>Cultivated land (not including Permanent Pasture)</i>	<i>Wheat Land</i>	<i>Permanent Pasture Land</i>	<i>Number of Sheep</i>	<i>Number of Cattle</i>
	<i>Thousands of acres</i>	<i>per thousand acres</i>				
Sussex	929	247	51	452	40	135
Warwick	601	237	54	605	367	196
Westmorland	497	74	0	418	802	148
Wilts	861	304	60	516	455	143
Worcester	455	273	56	572	278	153
Yorkshire E. Riding	748	598	80	306	576	125
Yorkshire N. Riding	1,357	238	14	397	511	132
Yorkshire W. Riding	1,763	194	26	470	362	152
All England	32,389	320	51	433	424	154

WALES

<i>County</i>	<i>Total Area</i>	<i>Cultivated land (not including Permanent Pasture)</i>	<i>Wheat Land</i>	<i>Permanent Pasture Land</i>	<i>Number of Sheep</i>	<i>Number of Cattle</i>
	<i>Thousands of acres</i>	<i>per thousand acres</i>				
Anglesey... ..	176	308	2	537	508	312
Brecon	466	78	5	349	1,041	85
Cardigan	441	208	11	379	554	149
Carmarthen	586	128	11	618	447	198
Carnarvon	362	128	1	345	721	142
Denbigh	424	198	11	418	879	167
Flint	162	236	21	542	553	244
Glamorgan	515	94	7	413	580	106
Merioneth	418	62	1	296	1,033	86
Montgomery	506	136	15	404	879	148
Pembroke	392	230	6	552	349	23
Radnor	300	124	6	414	926	110
All Wales	4,749	149	8	433	715	153

SCOTLAND

County	Total Area	Cultivated land (not including Permanent Pasture)	Wheat Land	Perma- nent Pasture Land	Number of Sheep	Number of Cattle
	Thousands of acres	per thousand acres				
Aberdeen	1,262	468	0	29	171	112
Argyll	1,990	27	0	37	387	30
Ayr	724	201	1	239	484	151
Banff	403	371	0	26	156	112
Berwick	293	476	5	177	1,116	70
Bute	140	102	0	79	301	65
Caithness	439	191	0	63	289	49
Clackmannan	35	249	10	194	405	103
Dumbarton	157	150	5	158	456	89
Dumfries	686	195	0	173	804	99
Edinburgh	234	337	27	191	780	83
Elgin or Moray	305	300	2	25	159	80
Fife	323	532	36	23	316	159
Forfar	559	392	18	52	281	96
Haddington	171	524	34	129	801	84
Inverness	2,695	32	0	24	184	18
Kincardine	244	444	3	44	196	114
Kinross	52	405	2	256	640	133
Kircudbright	576	161	0	168	665	96
Lanark	565	223	4	220	403	131
Linlithgow	77	432	30	310	251	161
Nairn	104	223	1	22	159	63
Orkney	241	377	0	71	145	128
Peebles	222	127	0	99	898	34
Perth	1,596	141	4	67	385	48
Renfrew	152	239	13	339	277	169
Ross and Cromarty	1,977	55	1	15	128	22
Roxburgh	426	260	1	156	1,250	48
Selkirk	171	88	0	86	1,057	20
Shetland	352	40	0	67	379	42
Stirling	289	185	6	212	427	110
Sutherland	1,298	17	0	7	156	9
Wigtown	312	355	0	145	355	182
All Scotland	19,070	173	2	79	357	65

IRELAND

County	Total Area	Cultivated land (not including Permanent Pasture)	Wheat Land	Perma- nent Pasture Land	Number of Sheep	Number of Cattle
	Thousands of acres	per thousand acres				
Antrim	713	314	1	532	128	232
Armagh	313	435	2	431	71	300
Carlow	221	319	3	565	435	240
Cavan	467	302	1	549	40	275
Clare	788	195	1	629	125	257
Cork	1,844	247	3	614	122	272
Donegal	1,194	182	0	611	134	153
Down	612	396	5	489	169	250
Dublin	227	312	12	574	244	297
Fermanagh	418	244	1	564	21	240
Galway	1,468	157	2	599	432	143
Kerry	1,162	148	1	649	99	247
Kildare	419	237	3	608	284	257
Kilkenny	509	283	3	612	171	303
King's	493	235	—	496	145	185
Leitrim	377	214	—	577	40	261
Limerick	664	247	2	662	50	393
Londonderry	515	331	1	541	126	207
Longford	258	257	1	520	99	257
Louth	202	403	2	509	214	252
Mayo	1,333	139	1	623	213	161
Meath	578	213	1	722	314	383
Monaghan	319	356	1	533	35	280
Queen's	425	310	1	554	116	221
Roscommon	608	221	0	569	266	238
Sligo	442	177	0	594	123	236
Tipperary	1,051	243	1	632	174	321
Tyrone	780	292	1	561	73	230
Waterford	454	171	0	634	135	269
Westmeath	435	189	0	630	252	283
Wexford	581	334	8	560	289	248
Wicklow	500	177	0	698	425	157
All Ireland	20,371	237	2	610	178	242

NOTES ON AGRICULTURAL STATISTICS

1. The ancient geographical counties are given above, with the exception that the figures dealing with the more recently formed county of London have been taken out from those dealing with the ancient geographical counties of Middlesex, Surrey, and Kent.

2. It will be noticed that the agricultural conditions are shown, not by giving the actual amount of land devoted to any purpose, but by the average amount devoted to that purpose out of every 1,000 acres in the county. In many cases it would be misleading to give the actual amount, as this would be greater in a large county than in a small one, even if the counties gave equal attention to the particular kind of cultivation.

For example, Bedford is shown above to give 125 out of every 1,000 acres to wheat, and this is a very high proportion; so that Bedford is shown to be a distinctly wheat-raising county. On the contrary, Devon is shown to give only 25 out of every 1,000 acres to wheat, and this is a very small proportion; so that Devon is shown to be not a wheat-raising county on the whole.

But Devon is very much larger than Bedford (note the total areas in the table above), and so the total amount of land given to wheat mounts up to about 42,000 acres, while Bedford has under wheat only about 38,000 acres. Therefore, if the total areas under wheat had been given, Devon would have appeared to be much higher in the scale of wheat-producing counties than Bedford, and a wrong idea of the kind of agriculture common in the counties would have been obtained.

Similarly the number of sheep and cattle per 1,000 acres,

and not the actual number in the county, is given to show whether a county is important in sheep-rearing or cattle-rearing.

Exercise 317. How do Rutland and Lancashire compare as regards wheat producing on the proportional figures given above? Rutland covers 97,000 acres, and Lancashire 1,195,000 acres. What are the actual amounts of land under wheat in the two counties? Would these actual amounts have misled you if they had been given instead of the proportion per 1,000 acres?

Exercise 318. Wales as a whole is shown above to give more attention to sheep-rearing than England gives as a whole. Which country produces the greater number of sheep? Would the actual number of sheep have misled you in this case?

Exercise 319. Show the proportions of cultivated land in the four regions. England, Wales, Scotland, and Ireland, for which statistics are given above, by the following graphic method.

Construct four rectangles each 5×2 inches, and divide each into its 10 square inches. Imagine that each square inch represents 100 acres and each rectangle would then represent 1,000 acres.

Let the first rectangle represent 1,000 acres in England; since of these 1,000 acres 320 are cultivated (see statistics), colour that proportion by marking off 3 square inches for the 300 acres and one-fifth of another square inch for the remaining 20 acres.

Let the second rectangle represent 1,000 acres in Wales; since of these 149 are cultivated, colour one square inch for the 100 acres and one-half of another for the remaining 49 acres.

Let the third rectangle represent 1,000 acres in Scot-

land, and colour one square inch for the 100 acres and three-quarters of another for the remaining 73 acres.

Let the fourth rectangle represent 1,000 acres in Ireland, and colour two and one-third square inches to represent the 237 acres of cultivated land.

Exercise 320. State in words what this diagram shows.

Exercise 321. Compare these facts with the proportions of upland in the various regions, and see if you can find a connexion between the two sets of facts.

Exercise 322. Show the distribution of cultivated land in the British Isles in more detail by the following

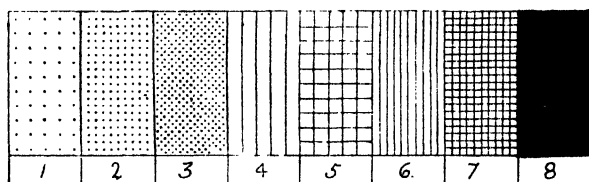


FIG. 25. Scheme for shading Diagrams and Maps.

method. Upon an outline map showing the county divisions, enter the numbers showing the proportion of cultivated land in each county. Shade or colour the map according to the following scale selected from Figure 25.

<i>Amount of Cultivated land per 1,000 acres</i>	<i>Shading</i>	<i>Colouring</i>
Below 100 acres	Unshaded	Uncoloured
From 100 to 199 acres	Sparsely dotted	Yellow
" 200 " 299 "	Closely dotted	Green 1 wash
" 300 " 399 "	Thin vertical lines	Green 2 washes
" 400 " 499 "	Close vertical lines	Blue 1 wash
500 acres or over	Close cross lines	Blue 2 washes

Exercise 323. Suggest reasons why there is so little

cultivation, in the case of each county in England, Wales, and Scotland, which has under 100 acres cultivated per 1,000 of the total area.

Exercise 324. Which are the best cultivated parts of Ireland? Account for this.

Exercise 325. Show the distribution of wheat land in the various counties of the British Isles, by the method described in Exercise 322 above. Use the following scale:

<i>Amount of Wheat land per 1,000 acres</i>	<i>Shading</i>	<i>Colouring</i>
Under 10 acres	Unshaded	Uncoloured
From 10 to 24 acres	Sparsely dotted	Yellow
„ 25 „ 49 „	Closely dotted	Green 1 wash
„ 50 „ 74 „	Thin vertical lines	Green 2 washes
„ 75 „ 99 „	Close vertical lines	Blue 1 wash
100 acres or over	Close cross lines	Blue 2 washes

Exercise 326. Describe the situation of the districts of the British Isles which grow the most wheat.

Exercise 327. 'Wheat requires warm dry weather for ripening.' Examine the rainfall map and the July temperature map and find whether the regions which have both the warmest and the driest weather in July are the chief wheat-growing regions.

Exercise 328. Show the proportion of permanent pasture land in the four regions, England, Wales, Scotland, and Ireland by the method described in Exercise 319 above. The square inches to be coloured will be about $4\frac{1}{3}$ in England, about $4\frac{1}{3}$ in Wales, $\frac{3}{4}$ in Scotland, and just over 6 in Ireland.

Exercise 329. Compare these diagrams showing the pasture land with those showing the cultivated land. In which regions is the pasture land greater, and in which is the cultivated land greater?

Exercise 330. Show the distribution of the pasture land in the British Isles in more detail by means of a map, colouring the separate counties according to the following scheme :

<i>Amount of Pasture land per 1,000 acres</i>	<i>Shading</i>	<i>Colouring</i>
Below 100 acres	Unshaded	Uncoloured
From 100 to 199 acres	Sparsely dotted	Yellow 1 wash
„ 200 „ 299 „	Closely dotted	Yellow 2 washes
„ 300 „ 399 „	Thin vertical lines	Green 1 wash
„ 400 „ 499 „	Thin cross lines	Green 2 washes
„ 500 „ 599 „	Close vertical lines	Blue 1 wash
600 acres or over	Close cross lines	Blue 2 washes

Exercise 331. Which districts in England give less than 300 acres per 1,000 to permanent pasture? Refer to the wheat map, and see if this suggests the reason.

Exercise 332. Compare Ireland and Scotland on the pasture map, and say what *products* you think will be obtained in far greater quantity in Ireland than in Scotland.

Exercise 333. Find reasons for this striking contrast between Scotland and Ireland.

Exercise 334. Construct a diagram to show the relative importance of sheep-rearing in England, Wales, Scotland, and Ireland, by the following method. Draw four rectangles as before, making each 10 square inches in area. In the first, representing 1,000 acres in England, put 424 dots to represent the 424 sheep per 1,000 acres. In the next, representing Wales, put 715 dots; in the third, representing Scotland, put 357 dots; in the last, representing Ireland, put 178 dots. The relative closeness of the dots shows the relative density of the sheep in each country.

Exercise 335. Show the distinction of the sheep

in the counties of the British Isles by a map, using the following scale :

<i>Sheep per 1,000 acres</i>	<i>Shading</i>	<i>Colouring</i>
Under 100 sheep	Unshaded	Uncoloured
From 100 to 249 sheep	Sparsely dotted	Yellow
„ 250 „ 499 „	Closely dotted	Green 1 wash
„ 500 „ 749 „	Thin vertical lines	Green 2 washes
„ 750 „ 999 „	Close vertical lines	Blue 1 wash
1,000 sheep or over	Close cross lines	Blue 2 washes

Exercise 336. Describe the situation of the districts which have the most sheep.

Exercise 337. Find out by comparing the sheep map with other maps, the physical conditions of those regions which are favourable for sheep-rearing.

Exercise 338. Construct a diagram to show the relative importance of cattle-rearing in England, Wales, Scotland, and Ireland, by the method described in Exercise 334 above.

Exercise 339. Show by means of a map the distribution of the cattle in the counties of the British Isles, using the following scale :

<i>Cattle per 1,000 acres</i>	<i>Shading</i>	<i>Colouring</i>
Under 50 cattle	Unshaded	Uncoloured
From 50 to 99 cattle	Medium dotted	Yellow
„ 100 „ 199 „	Thin vertical lines	Green
200 cattle or over	Close vertical lines	Blue

Exercise 340. Describe the situation of the districts which have the most cattle.

Exercise 341. Find out by comparing the cattle map with other maps the physical conditions which appear to be most favourable to cattle-rearing.

Exercise 342. In what respects is there a similarity between the pasture map and the cattle map? Why should there be any similarity?

Exercise 343. Taking the British Isles as a whole, are there more sheep or more cattle? Take the four large regions separately, and see if any is an exception to this rule. Suggest a reason.

Exercise 344. Examine the statistics showing the sheep and cattle in Cheshire. State in what respects this county is different from most English counties. Why is this?

Mineral Industries

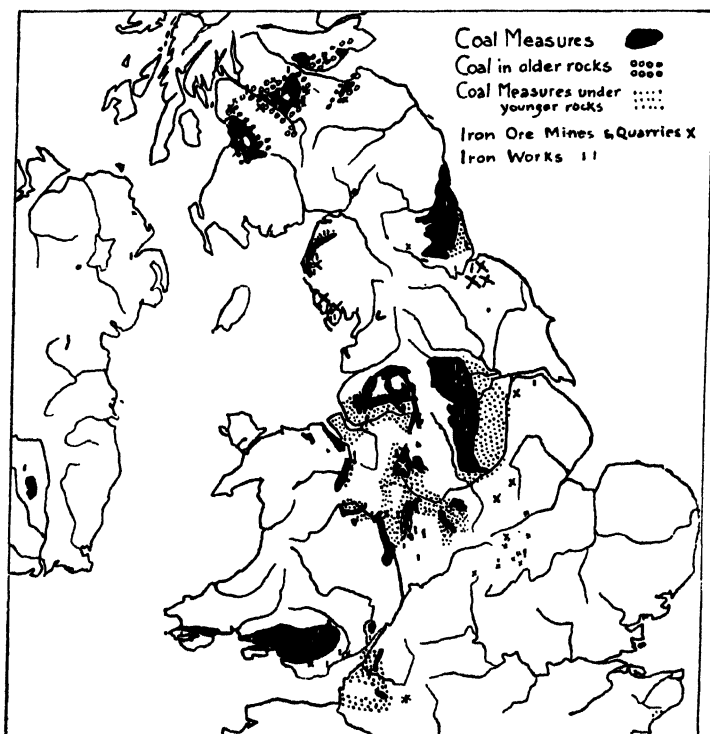


FIG. 26. Distribution of Coal, Iron Ore, and Iron Works in Britain.

Exercise 345. With the aid of the squared tracing paper measure on the map in Fig. 26 the areas of the following coal-fields. Rearrange these in order of area, and write against each the number of squares, and the names of the chief mining centres.

<i>Name of Coal-field</i>	<i>Area (number of squares)</i>	<i>Mining centres</i>
Scottish Coal-fields		
Northumberland and Durham		
Cumberland		
York, Derby, and Nottingham		
South Lancashire and Cheshire		
North Wales		
Midland		
South Wales		
Gloucester		
Somerset		

PRODUCTION OF COAL FROM THE VARIOUS COAL-FIELDS

(Average of recent years)

York, Derby, and Nottingham	75,000,000 tons
South Wales and Monmouth	45,000,000 "
Northumberland and Durham	43,000,000 "
Scottish... ..	33,000,000 "
Midland	22,000,000 "
Lancashire and Cheshire	17,000,000 "
North Wales... ..	3,000,000 "
Cumberland	2,000,000 "
Somerset	1,000,000 "
Gloucester	1,000,000 "
Ireland	100,000 "
Total... .. (about)	242,000,000 "

Exercise 346. Draw a series of rectangles to represent the production of the above coal-fields. Allow a width of $\frac{1}{4}$ inch for each coal-field and a height of 1 inch for every 10,000,000 tons of coal produced.

Exercise 347. Compare the figures showing the area with those showing the production. Do the two corre-

spond generally? Are there any cases where the order of importance is different according to which figures are used? Suggest reasons (several if possible) why the area should not be an accurate index of the production.

ESTIMATES OF COAL USED FOR VARIOUS PURPOSES

Factories	64,000,000 tons per annum
Domestic purposes	36,000,000 " " "
Collieries	17,000,000 " " "
Gasworks	15,000,000 " " "
Railways	14,000,000 " " "
Blast furnaces	14,000,000 " " "
Electricity	7,000,000 " " "
Exported and shipping	75,000,000 " " "
Total	242,000,000 tons per annum

Exercise 348. Construct a diagram to show the relative importance of the uses made of coal, by means of a series of rectangles allowing to each a width of $\frac{1}{4}$ inch and a height of 1 inch for every 10,000,000 tons.

PRODUCTION OF IRON ORE FROM THE CHIEF DISTRICTS

(Average of recent years)

<i>District</i>	<i>From Iron-mines and quarries</i>	<i>From Coal-mines</i>
Lincolnshire, Leicestershire, and Northamptonshire ...	7,000,000 tons	—
Yorkshire	2,000,000 tons	—
Cumberland and Lancashire	1,000,000 tons	—
Staffordshire	—	300,000 tons
Scotland	300,000 tons	300,000 tons
Ireland	100,000 tons	—

Exercise 349. What was the total production of iron ore? What proportion of this was obtained from coal-mines?

Exercise 350. Draw a series of rectangles to repre-

sent the production of the above districts. Allow a width of $\frac{1}{2}$ inch for each district and a height of 1 inch for each million tons of ore. Shade (by cross-ruling) the proportion of the ore from Scotland and Staffordshire which is obtained from coal-mines.

Exercise 351. Which portions of Yorkshire and Lancashire are referred to in the table? Which portions of Scotland? Why are Lincolnshire, Leicestershire, and Northamptonshire put together?

Exercise 352. Name the centres (1) in which the ores from each of the regions specified in the table are likely to be *smelted*, and (2) those in which the *manufacturing* is likely to be done.

Exercise 353. For what special purposes is the iron from each of these regions likely to be used?

SOURCES OF THE IRON ORE USED

(Average of recent years)

Home	11,000,000 tons
Imported... ..	5,000,000 tons
(Including from Spain)	2,000,000 tons)

Exercise 354. Draw a rectangle to show the total amount of iron ore used, making it 1 inch high with a length of $\frac{1}{8}$ or $\frac{1}{10}$ inch for every million tons. Cut off from the length the proportion imported, and shade it lightly; out of this portion cut off the area representing the import from Spain, and shade it deeply.

Exercise 355. Describe in words the comparative importance of the sources of the iron ore. Do you know of any other countries from which there is an import? Of what importance would you consider them?

PRODUCTION OF PIG IRON FROM ORE

Ore used	26,000,000 tons
Coal used	21,000,000 tons
Pig iron produced ...	10,000,000 tons

Exercise 356. The above figures show the amount of coal used for the blast furnaces (not the total used in the iron and steel industries), but the amount of limestone used cannot be ascertained. Draw a rectangle 1 inch wide, and allow a height of 1 inch for every 10,000,000 tons of material used. Cut off from the bottom of the rectangle an area to represent the amount of iron ore, and shade it lightly. From this cut off an area to show the amount of pig iron produced, and shade it deeply.

Exercise 357. What does the diagram suggest about the situation of places engaged in the smelting of iron ore? Consider the positions of Birmingham and Middlesbrough in this respect.

VALUE OF MINERALS PRODUCED

(Average of recent years)

Coal	£200,000,000
Rocks	£10,000,000
Ores	£4,000,000
(Of which Iron Ore is £3,000,000)	

Exercise 358. What was the total value of the minerals produced? What *proportion* of this value was due to: (1) Coal; (2) Rocks (such as Chalk, Clay, Granite, Limestone, Sand and Sandstone, Slate); (3) Iron Ore; (4) other Ores (chiefly Tin, Lead, and Zinc)?

Exercise 359. Draw a thick line about $5\frac{1}{2}$ inches long to represent the total value. Cut off from it lengths proportional to the values of the four classes mentioned in the preceding exercise. Write the name of the product which it represents against each length.

Commerce

FOREIGN TRADE OF BRITAIN (EXCLUDING THE
IRISH FREE STATE)*(Average of recent years)*

<i>Articles</i>	<i>Imports : Millions of £</i>	<i>Exports : Millions of £</i>
Total (approximate)	1280	760
Food, drink, and tobacco	550	55
<i>including—</i>		
Grain and flour	105	9
Animals and meat	135	2
Tobacco	17	7
Raw materials	410	85
<i>including—</i>		
Cotton	105	0
Wool	71	11
Flax, hemp, jute, &c.	16	0
Wood and timber	43	0
Oils, oilseeds, gums, &c.	50	7
Hides and skins	20	3
Iron ore	5	0
Other ores	15	0
Paper-making materials	11	2
Rubber	32	0
Manufactured goods	320	620
<i>including—</i>		
Cotton goods	9	190
Woollen goods	15	58
Silk goods	20	2
Other textiles	18	28
Apparel	19	28
Iron and steel goods and machinery	51	135
Other metals and metal goods	38	17
Ships and vehicles	10	33
Chemicals and colours	15	23
Leather and leather goods	15	7
Coal	0	50

Exercise 360. Construct a diagram showing the amount and nature of the import trade of Britain. Use squared paper, and draw to the scale of 1 square inch for each £10,000,000 of trade. First draw a large figure for the total import trade. Cut off from the bottom an area to represent the 'Food, Drink, and Tobacco' portion, and colour this red. Above this cut off another area to represent the 'Raw Materials' portion, and colour it yellow. Above this mark off the 'Manufactured Goods' portion, colouring it green. (The colouring should be light.)

Exercise 361. Construct a similar diagram showing the amount and nature of the export trade, using the same scale and colouring. Above the 'Manufactured Goods' portion, mark off an area to represent Coal, and colour this blue.

Exercise 362. Compare the two diagrams, and (1) state carefully the differences which appear; (2) suggest reasons for each difference.

Exercise 363. Take the import diagram, and mark off in the area for each group the area representing each commodity included, e.g. in the 'Raw Materials' portion mark off 10.5 square inches for Cotton. Write the name of each commodity in its area.

Exercise 364. Deal with the export diagram in a similar manner.

Exercise 365. Make a list of the commodities firstly in order of their importance as imports, and secondly in order of their importance as exports.

Exercise 366. Lancashire has about one-tenth the population of the British Isles. Assuming that it takes nine-tenths of the raw cotton and one-tenth

of the other materials, to how much would its imports amount?

Exercise 367. What is the amount of the import and export trade per head of the population of the British Isles? (See Exercise 390.)

Exercise 368. Which of the articles imported can be produced in this country? Why are they imported?

Exercise 369. Which of the articles imported cannot be produced in this country? Why can they not be produced here?

Exercise 370. Give reasons why this country exports the six most important articles of export?

TRADE OF THE GREATEST PORTS

(Average of recent years)

[Figures below show value of goods in millions of £]

1. LONDON. Imports, 373; exports, 133. *Chief articles imported:* Oils, fats, seeds, &c., 64; meat, 54; wool, 22; tea, 22; wheat and flour, 19; fruit, 18; iron and other metal goods, 15; butter, 14; sugar, 13; hides and skins, 12; timber, 12; cheese, 7; silk (raw and manufactures) 7; cocoa and coffee, 5; eggs, 5. *Chief articles exported:* Iron and steel goods and machinery, 21; woollen goods, 14; cotton goods, 12; apparel, 9; chemicals, dyes, &c., 7.

2. LIVERPOOL, WITH BIRKENHEAD. Imports, 223; exports, 248. *Chief articles imported:* Raw cotton, 68; meat, 34; oils, fats, nuts, &c., 16; wheat and flour, 15; sugar, 15; fruit, 15; raw wool, 8; tobacco, 8; metals and metal goods, 5; metallic ores, 5. *Chief articles exported:* Cotton goods, 96; iron and steel goods and machinery, 55; woollen goods, 20; chemicals and dyes, 9; linen goods, 7; earthenware and glass, 6; metals and metal goods, 5.

3. HULL, WITH GRIMSBY AND IMMINGHAM. Imports, 78; exports, 54. *Chief articles imported:* Oils, fats, seeds, &c., 12;

wool and yarns, 12 ; wheat and flour, 12 ; butter and margarine, 6. *Chief articles exported*: Cotton goods, 17 ; woollen goods, 8 ; iron and steel goods and machinery, 5.

4. MANCHESTER. Imports, 52 ; exports, 39. *Chief articles imported*: Raw cotton, 16 ; wheat and flour, 7. *Chief articles exported*: Cotton goods, 25 ; iron and steel goods and machinery, 9.

5. GLASGOW. Imports, 25 ; exports, 56. *Chief articles imported*: Wheat and flour, 5. *Chief articles exported*: Iron and steel goods and machinery, 17 ; ships, 10 ; cotton goods, 8 ; spirits, 6.

6. SOUTHAMPTON. Imports, 29 ; exports, 29. *Chief article imported*: Wool, 5. *Chief articles exported*: Cotton goods, 8 ; apparel, 6.

7. NEWCASTLE, WITH NORTH AND SOUTH SHIELDS, AND SUNDERLAND. Imports, 17 ; exports, 33. *Chief articles exported*: Coal and coke, 20 ; ships, 7.

8. BRISTOL. Imports, 33 ; exports, 6. *Chief articles imported*: Wheat, 6 ; tobacco, 5. *Chief articles exported*: Iron and steel goods and machinery, 5.

9. CARDIFF. Imports, 9 ; exports, 22. *Chief article exported*: Coal, 19.

10. LEITH. Imports, 17 ; exports, 7.

Exercise 371. Draw a series of rectangles to show the total amount of trade at each port. Each rectangle should have a breadth of $\frac{1}{4}$ inch, and a length of $\frac{1}{4}$ inch for each £10,000,000 of total trade.

Exercise 372. Mark off the portions of these rectangles showing imports and exports respectively (using the same scale of $\frac{1}{4}$ inch for £10,000,000) and colour these portions red and blue. Do most of the ports import or export the greater value of goods?

Exercise 373. The figures show only imports which come direct from abroad, and not those first landed at other ports and then transferred in coasting vessels or by train. How might this be inferred from the list of

articles imported into Glasgow, bearing in mind both its industries and its exports?

Exercise 374. Mention the probable destinations and the uses of the various goods imported at London. Why have they come to this port?

Exercise 375. Answer similarly as regards the goods imported at Liverpool.

Exercise 376. In what districts have the various goods exported from London been manufactured? Why are they sent to London to be exported?

Exercise 377. Answer similarly as regards the goods exported from Liverpool.

Exercise 378. How are the cotton goods from the Lancashire and Glasgow manufacturing districts distributed to places abroad? Mention both the routes and the proportions taking these routes.

Exercise 379. To what ports do you think the products of the Black Country are sent for export?

Exercise 380. Which coal-fields appear to export the most coal? Why is this?

Exercise 381. To what ports does tobacco come? Why?

Exercise 382. Do you think Liverpool would have appeared second on the above list if the Manchester Ship Canal had not been constructed? Give your reasons.

Exercise 383. Leith is a comparatively small town. How is it that it has a comparatively large trade?

Exercise 384. What is the amount of the joint import trade of Liverpool and Manchester? Does this agree with your estimate made in Exercise 366 of the imports of the county of Lancashire? Account for the difference.

Population

STATISTICS SHOWING THE POPULATION IN THE
COUNTIES AT THE CENSUS OF 1911

ENGLAND

County	Total Area in square miles	Total population	Persons engaged in Agriculture	Persons engaged in industries and commerce
		per square mile		
Bedford... ..	473	411	31	123
Berks	722	375	23	89
Buckingham... ..	749	293	24	70
Cambridge	864	229	33	44
Cheshire	1,027	930	32	318
Cornwall	1,357	242	21	56
Cumberland... ..	1,520	175	12	49
Derby	1,030	664	20	228
Devon	2,605	269	18	63
Dorset	977	229	20	49
Durham	1,011	1,355	15	438
Essex	1,530	942	30	260
Gloucester	1,243	592	22	185
Hants	1,621	586	21	136
Hereford	842	136	20	23
Hertford	632	493	29	120
Huntingdon... ..	366	149	24	27
Kent	1,526	685	34	165
Lancashire	1,887	2,527	28	1,058
Leicester	824	578	20	227
Lincoln... ..	2,646	213	24	51
London... ..	117	38,647	68	13,537
Middlesex	236	4,733	64	1,394
Monmouth	536	738	16	246
Norfolk	2,044	244	26	56
Northampton	1,003	347	20	116
Northumberland	2,015	341	9	109
Notts	843	717	21	322
Oxford	756	264	23	59
Rutland	152	134	17	23
Shropshire	1,347	183	19	41
Somerset	1,630	281	22	72
Stafford... ..	1,171	1,151	22	411

ENGLAND (*continued*)

<i>County</i>	<i>Total Area in square miles</i>	<i>Total population</i>	<i>Persons engaged in Agriculture</i>	<i>Persons engaged in industries and commerce</i>
		<i>per square mile</i>		
Suffolk	1,489	265	28	59
Surrey	722	1,171	31	278
Sussex	1,458	455	26	103
Warwick	902	1,153	22	441
Westmoreland	790	80	9	19
Wilts	1,350	212	19	49
Worcester	751	701	31	222
Yorkshire E. Riding ...	1,177	437	21	131
Yorkshire N. Riding ...	2,127	197	13	53
Yorkshire W. Riding ...	2,763	1,102	19	438
All England... ..	50,860	670	22	218

WALES

<i>County</i>	<i>Total Area in square miles</i>	<i>Total population</i>	<i>Persons engaged in Agriculture</i>	<i>Persons engaged in industries and commerce</i>
		<i>per square mile</i>		
Anglesey	276	148	26	36
Brecon	733	81	8	21
Cardigan	692	87	15	16
Carmarthen	918	175	17	50
Carnarvon	572	219	16	59
Denbigh	666	217	18	56
Flint	255	364	23	99
Glamorgan	808	1,400	14	484
Merioneth	659	69	9	16
Montgomery	797	67	13	12
Pembroke	614	147	18	32
Radnor... ..	471	48	9	8
All Wales	7,449	272	14	82

SCOTLAND

<i>County</i>	<i>Total Area in square miles</i>	<i>Total population</i>	<i>Persons engaged in Agriculture</i>	<i>Persons engaged in industries and commerce</i>
			<i>per square mile</i>	
Aberdeen	1,971	158	13	40
Argyll	3,110	23	3	7
Ayr	1,132	237	10	61
Banff	630	97	15	20
Berwick	457	65	11	7
Bute	218	83	7	17
Caithness	686	47	7	8
Clackmannan	55	570	10	208
Dumbarton	246	468	10	190
Dumfries	1,072	68	7	15
Edinburgh	366	1,387	18	434
Elgin or Moray	477	91	9	18
Fife	504	531	16	177
Forfar	874	322	11	121
Haddington	267	162	19	34
Inverness	4,211	21	3	4
Kincardine	382	107	14	22
Kinross	82	92	10	20
Kirkcudbright	900	43	5	8
Lanark	879	1,645	12	603
Linlithgow	120	667	17	203
Nairn	163	57	7	10
Orkney	376	69	17	10
Peebles	347	44	4	15
Perth	2,493	50	5	11
Renfrew	240	1,313	18	472
Ross and Cromarty	3,090	25	3	4
Roxburgh	666	71	8	18
Selkirk	267	92	4	35
Shetland	551	51	8	16
Stirling	451	357	9	111
Sutherland	2,028	10	2	1
Wigtown	488	66	11	10
All Scotland	29,819	157	7	49

IRELAND

County	Total Area in square miles	Total population	Persons engaged in Agriculture	Persons engaged in industries and commerce
		per square mile		
Antrim	1,192	487	26	161
Armagh	513	234	44	49
Carlow	346	105	23	13
Cavan	746	122	37	8
Clare	1,332	78	20	6
Cork	2,893	135	22	20
Donegal	1,877	90	24	8
Down	959	213	34	45
Dublin	354	1,348	32	364
Fermanagh	715	86	25	7
Galway	2,375	77	20	5
Kerry	1,859	86	18	8
Kildare	654	102	18	13
Kilkenny	800	93	26	11
King's	772	74	17	4
Leitrim	613	104	31	5
Limerick	1,064	134	23	20
Londonderry	818	172	29	31
Longford	421	107	30	8
Louth	317	201	33	39
Mayo	2,157	89	24	5
Meath	905	72	17	8
Monaghan	500	143	39	12
Queen's	664	82	21	9
Roscommon	984	95	29	5
Sligo	707	112	29	8
Tipperary	1,662	92	20	11
Tyrone	1,261	113	28	15
Waterford	717	117	19	19
Westmeath	710	84	19	10
Wexford	913	112	25	14
Wicklow	782	78	15	11
All Ireland	32,588	135	24	22

NOTES ON THE POPULATION STATISTICS

1. As in the agricultural statistics the ancient geographical counties are given, with the exception that the recently formed county of London has been separated from Middlesex, Surrey, and Kent.

2. The total population includes all adults, whether occupied or unoccupied, and also children; hence it is much more than the total of all occupations, and the figures are much greater than those relating to any occupation or group of occupations.

3. For the reasons given in the notes to the agricultural statistics, the populations are shown by the proportional number and not the actual number of persons. In this case, however, the proportion is the number of persons to the square mile. Thus the density of the population is indicated.

4. Although the figures relate to 1911, it is convenient to use them still because (*a*) the figures of a later census are not arranged in the same way which makes easy a comparison of the various regions, and (*b*) the changes which have occurred are not great enough to alter seriously the maps which will be made from them. The main change now going on is a growth of small industries in the counties around London.

Exercise 385. How many persons are engaged in agriculture in the counties of Huntingdon and Lincoln which each have twenty-four such persons to the square mile?

Exercise 386. Upon an outline map showing the county divisions of the British Isles, enter the numbers indicating the density of total population per square mile.

Shade or colour the map according to the following scale.

<i>Density</i>	<i>Shading</i>	<i>Colour</i>
Over 2,000 to 1 sq. mile	Black	Blue, dark
1,000 to 1,999 " "	Close cross lines	Blue, medium
500 to 999 " "	Close vertical lines	Green, 2 washes
250 to 499 " "	Thin verticle lines	Green, 1 wash
100 to 249 " "	Medium dotted	Yellow, 2 washes
50 to 99 " "	Sparsely dotted	Yellow, 1 wash
Under 50 " "	Unshaded	Uncoloured

Exercise 387. Similarly deal with the figures showing the distribution of the people engaged in agriculture. In this case use the following scale, and note that all the shades and colours should be light as the agricultural population is never great.

<i>Density</i>	<i>Shading</i>	<i>Colour</i>
Over 30 to 1 sq. mile	Thin vertical lines	Green
From 21 to 30 " "	Closely dotted	Yellow, 3 washes
" 11 to 20 " "	Medium dotted	Yellow, 2 washes
" 6 to 10 " "	Sparsely dotted	Yellow, 1 wash
" 1 to 5 " "	Unshaded	Uncoloured

Exercise 388. Similarly deal with the figures showing the distribution of the people engaged in industries and commerce. Use the following scheme, and note that it is identical with that of the preceding exercise in the less densely populated areas, but has also more densely populated areas and therefore additional and darker shades and colours.

<i>Density</i>	<i>Shading</i>	<i>Colour</i>
Over 240 to 1 sq. mile	Black	Black
From 121 to 240 " "	Close cross lines	Blue, dark
" 91 to 120 " "	Close vertical lines	Blue, medium
" 61 to 99 " "	Thin cross lines	Green, 2 washes
" 31 to 60 " "	Thin vertical lines	Green, 1 wash
" 21 to 30 " "	Closely dotted	Yellow, 3 washes
" 11 to 20 " "	Medium dotted	Yellow, 2 washes
" 6 to 10 " "	Sparsely dotted	Yellow, 1 wash
" 1 to 5 " "	Unshaded	Uncoloured

Exercise 389. Draw diagrams to show the density of population in the four regions, England, Wales, Scotland, and Ireland. Construct four equal squares, and in them place dots each representing ten persons to the square mile. Thus, in the second place twenty-seven dots to represent the 272 persons per square mile in Wales, in the others place sixty-seven, sixteen and fourteen dots to represent the density of population in England, Scotland, and Ireland respectively.

Exercise 390. Fig. 27 shows at one time three sets of fact: (1) relative areas of the countries in 1901 by the areas of the diagrams; (2) the populations by the

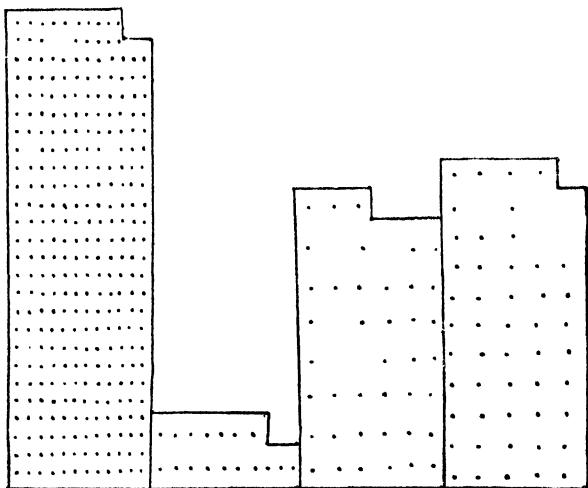


FIG. 27. Areas, Populations, and Densities of Population of England, Wales, Scotland, and Ireland in 1901.

number of dots; (3) the densities of population by the closeness of the dots. The following statistics give the areas and populations in 1921 in round numbers:

	<i>England</i>	<i>Wales</i>	<i>Scotland</i>	<i>Ireland</i>
<i>Sq. miles</i>	51,000	7,000	30,000	33,000
<i>Persons</i>	35,700,000	2,200,000	4,900,000	4,400,000

Draw a similar figure on squared paper, allowing one unit of area (e.g. one square) for every 1,000 square miles, and then insert the dots, putting one dot for every 100,000 persons.

Exercise 391. The number of persons engaged in industries and commerce in the countries is as follows:

<i>England</i>	<i>Wales</i>	<i>Scotland</i>	<i>Ireland</i>
11,094,000	613,000	1,474,000	725,000 persons

Construct a diagram to show: (1) the relative area, (2) the industrial and commercial population, (3) the density of this population. (This diagram should be constructed in the manner indicated in the preceding exercise.)

Exercise 392. The following figures give the number of persons engaged in agriculture:

<i>England</i>	<i>Wales</i>	<i>Scotland</i>	<i>Ireland</i>
1,128,000	107,000	200,000	781,000 persons

Construct a diagram to show the relative area, agricultural population, and density of agricultural population, using the method shown above. Note that as the numbers engaged in agriculture are much less, the scale of dots must be altered, and it would be well to put one dot for every 10,000 persons.

Exercise 393. Contrast the densities of population indicated by the diagrams of the two preceding exercises.

Exercise 394. Examine the map of Exercise 386 and describe in words the chief features of the distribution

of the total population in the British Isles, and account for the general arrangement.

Exercise 395. Make a list of the counties which have more than 1,000 persons to the square mile, placing them in order of the density of population. How many are in England, Wales, Scotland, and Ireland respectively?

Exercise 396. Account for each of these exceptional densities, and in particular give the names of the large towns which help to increase the average density of population in these counties.

Exercise 397. Make a list of the counties which form part of the great coal-fields, and against each county place the densities of the total population. What do you notice about these densities and what conclusions do you draw from them?

Exercise 398. Account for the relative densities of total population in the three Ridings of Yorkshire under these headings: Resources, Occupations, Towns.

Exercise 399. Arrange the counties of Scotland into three groups: Highlands, Lowlands, Southern Uplands. Find the average of the densities of the population in each group of counties, and suggest reasons for the results you obtain.

Exercise 400. Which areas of Ireland are the most densely populated? Why is this?

Exercise 401. Calculate the percentage of the total population which is engaged in industries and commerce in the four divisions, England, Wales, Scotland, and Ireland. (The figures necessary for the calculation are given in preceding exercises.)

Exercise 402. Arrange the divisions in the order of

the percentages just found, and suggest reasons for the proportion being so low in Ireland.

Exercise 403. Calculate the percentage of the total population which is engaged in agriculture in the four divisions, England, Wales, Scotland, and Ireland. (The necessary figures are given in preceding exercises.)

Exercise 404. Arrange the divisions in the order of the percentages just found, and suggest reasons for the proportion being so high in Ireland.

Exercise 405. Which counties of England and Wales have more people engaged in agriculture than in industries and commerce? What do you notice about the total population of these counties? Are they of sufficient importance to affect the general condition of England and Wales to any considerable extent?

Exercise 406. Which counties of Scotland have more people engaged in agriculture than in industries and commerce? Where are they situated?

Exercise 407. Do the statistics bear out the following statement? 'Ireland is an agricultural country; England is a manufacturing country.' Are any counties of Ireland exceptions to this rule?

POPULATIONS OF THE LARGEST CENTRES AT THE CENSUS OF 1921

London ('Greater London')	...	7,500,000	persons
Glasgow	...	1,050,000	"
Manchester with Salford	...	970,000	"
Liverpool with Birkenhead	...	950,000	"
Birmingham	...	920,000	"
Sheffield	...	490,000	"
Leeds	...	460,000	"
Belfast	...	420,000	"
Edinburgh	...	420,000	"
Bristol	...	380,000	"
Dublin	...	310,000	"
Bradford	...	290,000	"
Newcastle-upon-Tyne	...	280,000	"
Nottingham	...	260,000	"

Exercise 408. Draw a series of rectangles to show the relative sizes of these centres, allowing one square inch for every 250,000 persons.

Exercise 409. In each rectangle write the name of the centre with the occupations that are largely carried on at that centre.

Exercise 410. Take each centre in order, and in each case make a list of the important occupations, writing against them any advantages which the centre possesses for the carrying on of the occupations.

Exercise 411. Of these twelve large centres, how many are in England, Scotland, and Ireland respectively? Account for this distribution of the large towns.

Exercise 412. Rearrange the centres in two groups under the following headings: (1) Centres that can be reached by ocean-going steamers. (2) Centres with inland navigation only. Which group has the greatest aggregate population? What does this suggest?

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PRACTICAL
GEOGRAPHY

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PRACTICAL GEOGRAPHY

MAP-MAKING

Plane-Tabling

In Exercises 1, 2, and 3 the same area will be mapped in different ways in order to compare the speed and the accuracy of results of these methods.

Exercise 1. *To make a sketch-map of a small area.*

Place a drawing-board in a fixed position in the centre of a field or playground. Fasten a sheet of paper on the board and place a dot in the centre of it to represent the position of the board on the ground.

From the dot draw a line on the paper in the direction of some object, e. g. a tree on the edge of the ground, or a corner or gate in the wall. Pace the distance from the board to the object, and using a convenient scale such as 10 paces to the inch measure the distance on the paper along the line from the dot. Put a suitable mark at the spot to represent the object, naming it if necessary.

Draw similar lines to other objects, and estimate and mark off the distances as before.

When sufficient points have been obtained join up those on the boundaries of the ground, and draw other features, such as paths, from one point to another. Fill in other details by judging distances by the eye, having regard to the points already ascertained.

Exercise 2. *To make a plane-table survey from one station.*

The method of sketching described above is both in-

accurate and slow ; for more accurate and quicker surveying a plane-table is used.¹ This is a board placed on a movable stand so that it can be made quite level and turned in any direction.

Set up the plane-table in the centre of the ground, and level it. This is done with the aid of a spirit level, putting it first parallel to the longer sides of the board and adjusting the board so that the bubble is in the centre of the level, and then putting the level at right angles to the longer sides and adjusting the board in this new direction.

Next draw a line on the paper to show the direction of the magnetic N. and S., by drawing along the edge of the compass box provided with the plane-table.

Place a mark ($\odot$) in the centre of the paper to indicate the position of the plane-table station.

Select some object within measurable distance and sight it by placing the edge of the sight-rule against the station-mark and turning the rule so that on looking through the slit in the nearer sight the object to be marked can be seen behind the vertical wire in the farther sight. Draw a line from the station-mark along the edge of the sight-rule ; this line shows the direction of the object.

Measure with a chain or tape the distance from the station to the object, and measure this distance along the line on the paper according to a suitable scale. (The scale should always be indicated on the side of the paper.) Mark the position of the object, naming it if necessary.

¹ Simple and cheap plane-tables with accessories are sold by several makers, including A. H. Baird, Lothian Street, Edinburgh ; Philip Harris & Co., Edmund Street, Birmingham ; and G. Philip & Son, Fleet Street, London. It is necessary to see that the stand is sufficiently stable—few cheap plane-tables are supplied with strong enough legs.

Similarly draw other lines to other points, measuring and marking their distances from the station. Always use the same edge of the sight-rule to rule by. Fill in other details as suggested in the preceding exercise.

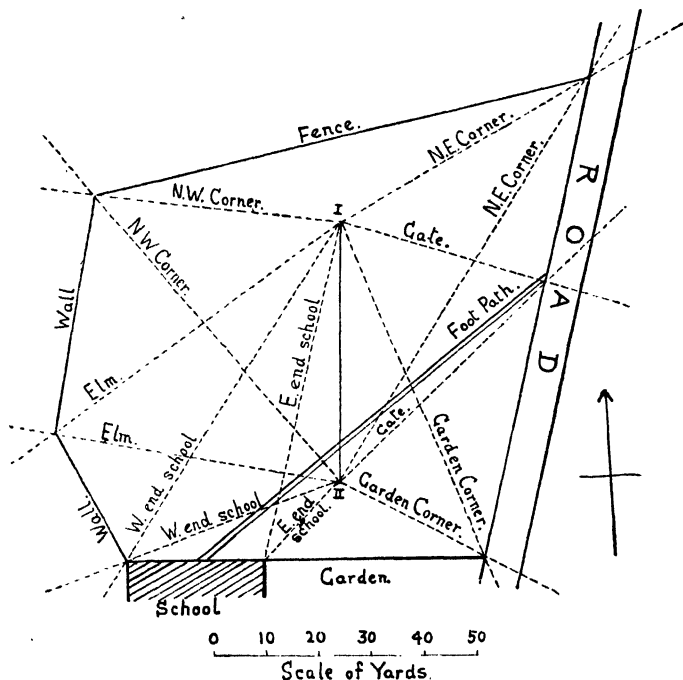


FIG. 1. Plane-Table Survey of Playground from two Stations

Compare this map with the sketch-map, and find where the second is more accurate than the first.

Exercise 3. *To make a plane-table survey from two stations.* (See Fig. 1.)

Fix two stations one near each end of the ground. At station I set up the plane-table, levelling, marking the

magnetic N. and S. line, and inserting a scale as before. At station II put a flag or post.

Place a mark ($\odot$ I) near one end of the paper to represent the position of station I. From the centre of this mark draw a line in the direction of station II, using the sight-rule as before. Measure the distance from station I to station II very carefully, and set off this distance along the line on the paper. At the proper spot place a mark ($\odot$ II) to represent the position of station II.

The line between the stations is called the base line, and is the only one that need be actually measured. The rest of the survey will be based upon this line; thus it is essential that the greatest care should be used in making it accurate in direction and in length.

From station I sight lines to various objects and draw the directions on the map. Write along each line the name of the object in the direction of which it is drawn, but do not measure the distances from the station. Select such objects as are visible from both stations, but as far as possible avoid those whose direction lines would lie near the base line.

Place a flag at station I and take the plane-table to station II. Set it up and level it, and then orient it by turning it until the magnetic N. and S. line already drawn coincides with the magnetic N. and S. line as shown by the compass. Place the edge of the sight-rule at the centre of the mark $\odot$ II, sight back to station I, and observe if the edge of the sight-rule coincides with the base line on the map. If it does, the survey may proceed; if it does not, the work must be recommenced and made accurate.

From station II sight the objects already sighted from

station I, draw their direction lines to the point where each intersects on the paper the corresponding direction line from station I. Mark the position of each object at the intersection, and fill in the survey as described in Exercise 1.

Notice that by this method the objects whose positions are mapped may be at a considerable distance and in inaccessible places, e.g. on the other side of a stream.

Compare this survey with the preceding ones in respect to (a) accuracy, (b) speed.

Contouring

Exercise 4. *To find the relations between heights, distances, and slopes.* (See Fig. 2.)

On a large sheet of paper draw a horizontal line, and with a protractor draw another line at an angle of 5° to the first. Produce both lines nearly as far as the paper will allow. At the end of the horizontal line erect a perpendicular to meet the slanting one, so as to enclose a right-angled triangle.

Let the slanting line represent a part of the slope of a hill; then the vertical line will represent the difference in height between the top and the bottom of the slope and the horizontal line will represent the distance from the top to the bottom of the slope as it would appear on a map. The vertical line is called the vertical interval (*V.I.*), and the horizontal line is called the horizontal equivalent (*H.E.*) of this interval.

Measure the *V.I.* and the *H.E.* in your figure, and put the result in the following form:—

‘With a slope of 5° , a *V.I.* of . . . inches has a *H.E.* of . . . inches.’

By proportion, work out the following relationships :—

‘With a slope of 5° , a *V.I.* of 20 feet has a *H.E.* of . . . feet.’

‘With a slope of 5° , a *V.I.* of 20 feet has a *H.E.* of . . . yards.’

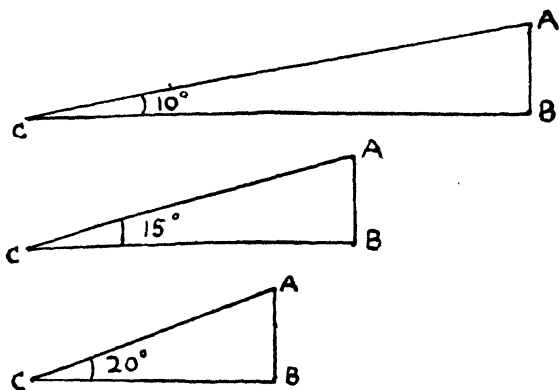


FIG. 2. Diagram showing that the Horizontal Equivalent (CB) of any given Vertical Interval (AB) decreases as the angle of the slope increases. (Note that while the length of AB remains the same, the length of CB changes; therefore to descend 20 feet on a gentle slope necessitates more ground being covered than the same descent on a steep slope)

Compare this result with that given in the table below.

Construct a similar figure with a slope of 10° , and find the *H.E.* of a *V.I.* of 20 feet, expressing the *H.E.* in yards. Compare the result with that given in the table.

By constructing similar figures with slopes of 16° to 20° , calculate to the nearest yard the *H.E.*'s for *V.I.*'s of 20 feet, and insert the results in the table below.

HORIZONTAL EQUIVALENTS OF A VERTICAL INTERVAL OF 20 FEET

<i>Slope.</i>	<i>H. E.</i>	<i>Slope.</i>	<i>H. E.</i>
1°	382 yards	11°	34 yards
2°	191 yards	12°	31 yards
3°	127 yards	13°	29 yards
4°	95 yards	14°	27 yards
5°	76 yards	15°	25 yards
6°	63 yards	16°	
7°	54 yards	17°	
8°	47 yards	18°	
9°	42 yards	19°	
10°	38 yards	20°	

Exercise 5. *To measure heights on a slope and insert them on a map.*

Obtain a tracing from a map (on a scale of at least 25 inches to 1 mile) of a hill the height of whose summit is known. Imagine this height to be 212 feet; it is required to mark levels at every 20 feet down the hill, from the level of 200 feet, so that the position of the 200-feet level must first be obtained. For this kind of work two people must act together.

Place a distinct mark upon a rod at the level of your eye. Send your companion with the rod down the hill in the direction of an object that is marked on the map and visible from the summit. Draw on the map the line from the summit to the object to show the direction of the rod. The rod-man should be sent as far down the hill as the slope is uniform, i. e. not farther than a marked change of slope, but not too far for the mark on it to be clearly visible.

Look towards the rod along a clinometer and tilt it until the mark can just be seen. Read the angle marked by the bob at the bottom of the clinometer; this angle indicates the slope of the hill. Suppose the slope to

be 5° . Refer to the table above, and note that with a slope of 5° a *V. I.* of 20 feet would have a *H. E.* of 76 yards. Therefore if one walked 76 yards towards the rod one would reach a level 20 feet below the summit.¹ But a level of 12 feet below the summit is required; therefore the following calculation must be made: Since 12 feet is $\frac{12}{20}$ of 20 feet, the distance from the summit must be $\frac{12}{20}$ of 76 yards, i. e. (nearly) 46 yards.

Move 46 yards down the slope towards the rod; you are now at a level of 200 feet. Put a mark at this spot. Set off on the map 46 yards (according to the scale) from the summit of the hill along the marked line. Place a mark on the map to indicate the 200-foot level.

Next locate a spot where the height is 180 feet. If necessary send the rod farther down the hill in the same direction. Stand at the 200-foot level and with the clinometer observe the slope to the rod. Suppose this to be 7° ; from the table find the *H. E.* of a *V. I.* of 20 feet if the slope is 7° . Since this is 54 yards, walk this distance down the hill towards the rod; measure 54 yards on the map and mark this new position on the ground and on the map as the 180-foot level.

Similarly find and mark the remaining levels at vertical intervals of 20 feet until the bottom of the hill is reached.

Exercise 6. *To mark contours along a hillside and insert them on a map.*

Suppose the contours on the slope considered above are to be observed and inserted on the map. Stand at the

¹ This statement is not strictly accurate, as the length of the line along the slope is not quite the same as the *H. E.* But unless the angle of the slope is great, and unless the survey has to be made with extreme accuracy, the difference between the length down the slope and the *H. E.* may be neglected. Test this statement by measuring the base and hypotenuse of the triangles you drew in Exercise 4.

level of 200 feet, and observe the lie of the ground on one side of you. For some distance on this side stick pieces of wood in the ground where it is on the same level, judging as well as you can with the eye. These pieces of wood indicate the 200-foot contour line. Observe the course of this line, e.g. whether it runs at right angles to the direction you have marked out

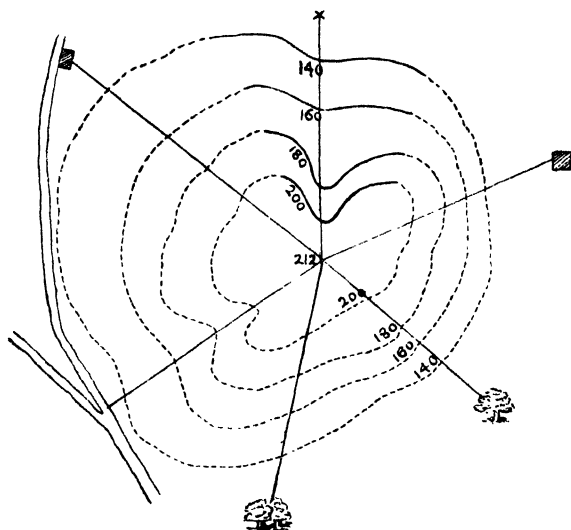


FIG. 3. Diagram showing method of drawing contour lines round a hill. The continuous contour lines are those drawn during the first descent.

down the slope, or whether it bends towards the higher part or towards the lower part of the hill. Sketch the course of the line as accurately as possible on the map from the mark showing the 200-foot level. Similarly mark out with sticks and then sketch on the map the course of the same contour line on the other side of your position.

Stand at the 180-foot level and insert the course of the

180-foot contour line in the same way. Proceed similarly with the remaining contour lines.

Exercise 7. *To insert the contour lines completely around a hill.* (See Fig. 3.)

Suppose that the same hill is to be completely contoured. The contour lines have already been inserted for a little distance on one face of it.

Return to the summit and work down the hill, inserting heights and contours as before, but at such a distance from the first that the new portions of the contour lines will join those already inserted.

Again return to the summit and work downward, but farther round the hill; repeat the survey until the whole circuit has been completed.

WEATHER CHANGES AND THEIR CAUSES

The Pressure of the Air

To study and understand weather changes it is necessary to know the pressure of the air, that is, the force with which the air presses outward in all directions. This is measured by the barometer, in which the mercury is forced up to a higher level when the pressure is great than when the pressure is slight. Thus, if the height of the mercury in the tube is observed to be 30 inches, the air pressure is said to be 30 inches, and this pressure is greater than when the height of the mercury is observed to be 29 inches.

In careful work a correction has to be made to allow for the mercury itself expanding or contracting on account of changes of temperature, but this correction need not be made in the following exercises.

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Observations should be made at least once a day, and at the same time every day. At the stations which send their results to the Meteorological Office in London the observations have for many years been made at 8 a.m. and at 8 p.m., and from these results the Daily Weather Maps and Forecasts published by the Meteorological Office are compiled. In order to compare your results with these, make your observations as nearly as possible

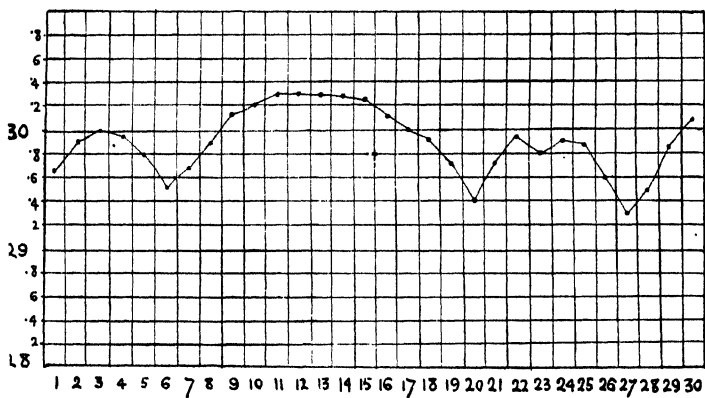


FIG. 4. Chart of Mean Daily Pressures for one Month

at 8 a.m. [To agree with Continental practice, a change to 7 a.m. has lately been made at most British stations.]

Exercise 8. Read the barometer each morning for one month, and plot the readings on a chart as in Fig. 4. (If you live high above the sea-level you may have to mark the base line of the chart 27 inches.) Calculate the mean pressure for the month and draw a line across the chart at this level. Answer the following questions regarding your records:—

1. On what date was the air pressure greatest?

2. By how much is the greatest pressure above the mean?
3. On what date was the air pressure least?
4. By how much is the least pressure below the mean?

Air Pressure and Altitude

The pressure which any particular mass of air exerts is due to the weight of the air above it. Hence, as the amount of air above is less at high levels than at low levels, the air pressure must be less at high levels than at low levels.

Exercise 9. Read the barometer carefully when the instrument is at as low a level as possible, e.g. in the basement of a building, or in a valley, or near the sea-shore. At once take the barometer to the greatest height possible, e.g. to the top of a high building, to the top of a hill or on a cliff. Read it again, and record the difference between the two readings.

Find the difference of height between the two levels at which the readings were taken, and, by proportion, calculate the height to which you would have to take the barometer to observe a fall of the mercury of 1 inch.

Exercise 10. The altitude which corresponds to a fall of the mercury of 1 inch varies according to certain circumstances, of which the temperature is the chief, but for the present purposes it may be taken as 900 feet. Find the height of your barometer above the sea-level, calculate what the difference of pressure would be if it were taken to the sea-level, and add this difference to all your future observations. You will now be able to compare your readings with those of other observers who have also made the reduction to sea-level.

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Adopting this estimate of 900 feet, calculate the height of a hill at the bottom of which the barometer recorded

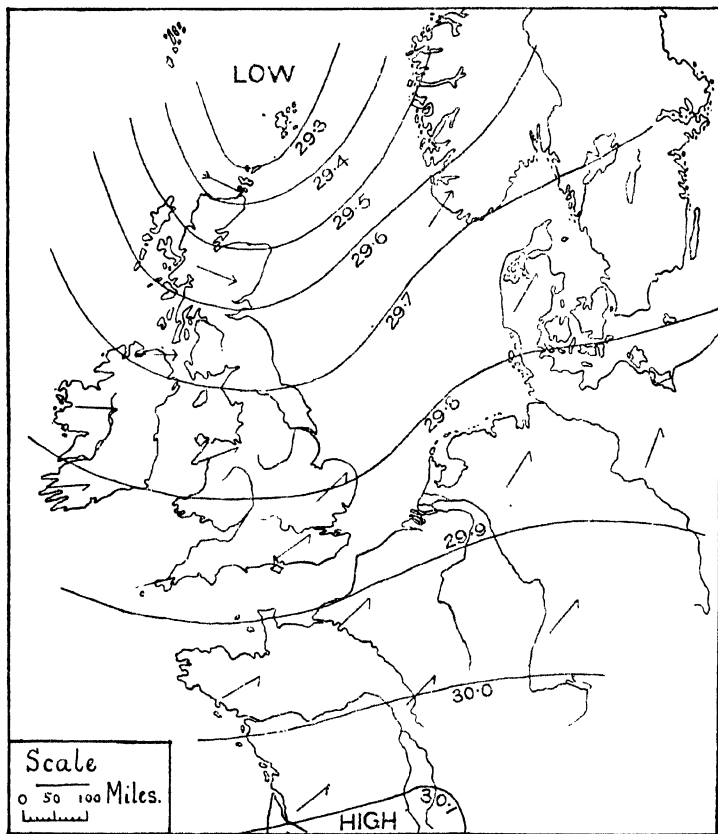


FIG. 5. Weather Map showing Isobars and Winds over the North-West of Europe.

a pressure of 29.97 inches, while at the top the reading was 28.33 inches.

Air Pressure and Winds

The pressure of the air at different places may be represented upon a map by figures showing in inches the height at which the mercury stands at the different places. Usually the reduction to sea-level is first made. Lines are then drawn through all places with the same pressure, and these lines are called isobars.

Exercise II. Fig. 5 is a map showing, by means of isobars, a frequent arrangement of the pressure of the air over the north-west of Europe.

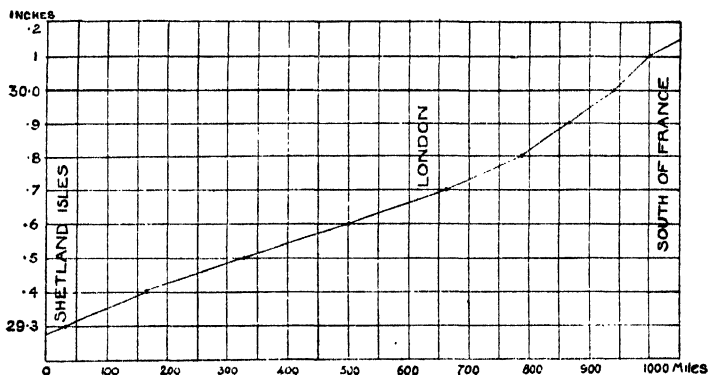


FIG. 6. Diagram showing Barometric Gradient.

What do the words 'LOW' and 'HIGH' signify? Describe in words the general arrangement of pressure. What do you estimate the pressure at London to be? At the Shetland Islands? Are you certain of this last estimate? Why?

Exercise 12. Make a tracing of the isobars in Fig. 5, and draw a line from the Shetland Islands to the south of France. Show the pressures along this line by a

diagram similar to that in Fig. 6. Adopt a method similar to that used in making sections of the relief of the land, and treat the isobars as though they were contour lines. Employ a horizontal scale of 200 miles of country to 1 inch on the section, and a vertical scale of $\frac{1}{16}$ inch of pressure to $\frac{1}{4}$ inch on the section, taking the level of 29 inches as the bottom of the diagram. Assume that the lowest pressure is 29.25 inches, and that the highest is 30.14 inches.

What would be the slope of the curved line in the diagram if the pressure were the same throughout the region? How would the slope alter if the pressures differed much more than they do? The difference between the pressures at two places is called the barometric gradient; state how the slope of the upper line in the diagram represents the barometric gradient.

Exercise 13. If at one place the pressure is 30.1 inches, and at a neighbouring place the pressure is 30.0 inches, what will be the effect of this difference of pressure on the intermediate air?

On your diagram representing the barometric gradient put a mark at the point midway between the places where the pressures of 30.1 and 30.0 inches are respectively, and indicate by an arrow what you would expect to be the direction of the movement of the air at this point. How does the air move in relation to the barometric gradient?

Exercise 14. Suggest a rule connecting the direction of winds with the relative pressures expressed by the terms 'high' and 'low'.

Exercise 15. Examine the map in Fig. 5 and notice the arrows showing the actual direction of the winds. What proportion of them show the winds as blowing

from places where the pressure is higher to places where it is lower?

Do the arrows point directly along the shortest course from a higher to a lower isobar, i. e. directly down the barometric gradient? Do they go to the right or to the left of this direction? Are there any exceptions to this rule? From these results suggest a more exact rule connecting the direction of the wind with the isobars. (The deflection of the winds towards the right of the shortest course from higher to lower isobars in the Northern Hemisphere is due to the rotation of the Earth: the deflection is towards the left in the Southern Hemisphere.)

Exercise 16. Is the steepness of the barometric gradient as represented in Fig. 6 the same at all points? Where is it steepest? What does this steepness tell you about the differences of pressure in this part?

Compare the barometric gradient as shown in Fig. 6 with the isobars as shown in Fig. 5. Suggest a rule stating the relation between the steepness of the barometric gradient and the closeness of the isobars.

Exercise 17. Examine the map in Fig. 5, and find where the barometric gradient is steepest and where it is least steep. At the part of the diagram where the gradient is steepest put two marks to represent places 100 miles apart, and measure the difference of pressure between these places. Deal similarly with the part of the diagram where the gradient is least steep.

Where is the difference of pressure greatest? Where would the air move most quickly? Suggest a rule stating the relation between the steepness of the barometric gradient and the velocity of the wind.

Exercise 18. The velocity of the wind is indicated according to the *Beaufort Scale* as follows :—

<i>Description.</i>	<i>Miles per hr.</i>	<i>Numerical Symbol.</i>	<i>Map Symbol.</i>
Calm	2 or less	0	⊙
Light air	4	1	} —————→
Light breeze	7	2	
Gentle breeze	10	3	
Moderate breeze	14	4	} —————→
Fresh breeze	19	5	
Strong breeze	25	6	
Moderate gale	31	7	} >————→
Fresh gale	37	8	
Strong gale	44	9	
Whole gale	53	10	} >>————→
Storm	64	11	
Hurricane	77	12	

Examine the map in Fig. 5, and compare the force of the winds as indicated by the arrow symbols with the steepness of the barometric gradients. Take your tracing of the isobars, and insert wind-arrows as marked on the map, and place against each the velocity in miles per hour, estimating the velocity in accordance with the barometric gradient as shown by the closeness of the isobars in each case.

Weather in Low Pressure Systems or Cyclonic Weather

Exercise 19. Examine the map in Fig. 7 and describe the general arrangement of the air pressures. A system of this kind is called a low pressure or cyclonic system or cyclone. Draw a diagram to show the barometric gradients along a line drawn through the centre of the cyclone, and passing through the south-western corner of Ireland and the south-eastern corner of Sweden. Use the scale given in Exercise 12, and assume that the lowest pressure is 29.61 inches.

Exercise 20. Examine the arrows on the map and see whether their directions bear out the relation between

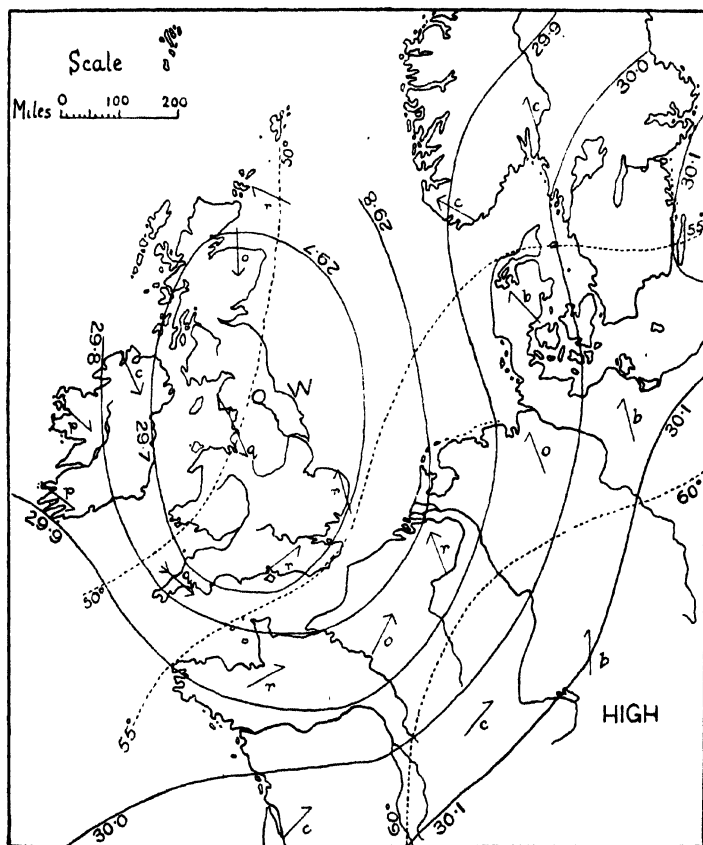


FIG. 7. Weather Map showing Cyclonic Conditions. First Day.

pressures and wind-directions suggested in a previous exercise. Do the winds blow round the area of low pressure in a 'clockwise' direction (i. e. in the same

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direction in which the hands of a clock move), or in a 'counter-clockwise' direction?

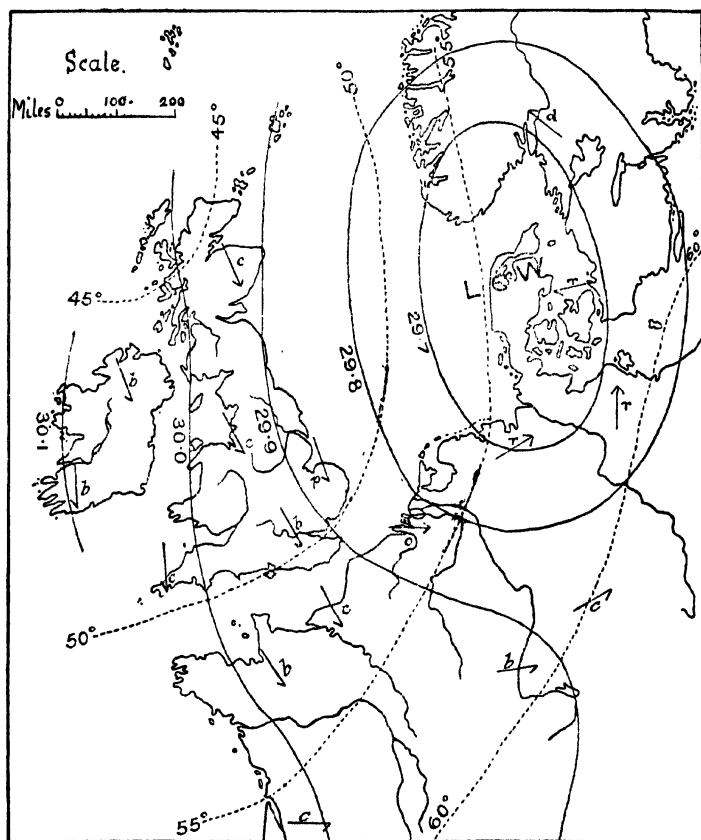


FIG. 8. Weather Map showing Cyclonic Conditions. Second Day.

In which part of the area shown in the map are the winds most violent and in which part least violent? Do the velocities of the winds bear out the rule suggested in Exercise 17?

Exercise 21. The isotherms, shown by dotted lines, are based on the temperatures observed at the stations and reduced to sea-level. From these describe the distribution of temperature in the following divisions of the cyclonic area :—West ; Centre ; East ; Distant East ; North ; South.

Assuming that southerly winds raise the temperature of the places to which they blow, and that northerly winds have the opposite effect, suggest the effect of this cyclone upon the temperature in each division.

Exercise 22. The weather conditions are shown for the same stations for which the wind directions are inserted. The following is the list of abbreviations in the *Beaufort Scale* :—

b. = blue sky ; c. = detached clouds ; bc. = sky half-clouded ; d. = drizzling rain ; f. = fog ; g. = gloomy ; h. = hail ; l. = lightning ; m. = misty ; o. = overcast ; p. = passing showers ; q. = squally ; r. = rain ; s. = snow ; t. = thunder ; u. = ugly (threatening) ; v. = visibility (unusual transparency) ; w. = dew.

Describe the weather conditions as shown on the map, using the divisions of the cyclonic area suggested in the preceding exercise.

Exercise 23. Fig. 8 shows the same cyclone one day later. Describe the general arrangement of pressures at this time. Draw a diagram to show the barometric gradient along the same line as before, using the same line as before, using the same scales and assuming the lowest pressure to be 29.64 inches.

Compare the diagrams and maps, and state (1) the direction in which the central low pressure has moved ; (2) the distance it has travelled ; (3) the average rate of movement per hour.

Exercise 24. Find the pressures at the mouth of the Elbe on the first day and on the second day. What difference is there between the two readings? Was the barometer rising or falling during the first day in this part of the area? Answer the same questions with regard to the centre of Ireland.

As the cyclones in this part of the world usually move towards the east, these two maps may be considered as representing a common type of weather changes, and we may call the region to the east of the centre the front of the cyclone, and the region to the west of it the rear of the cyclone. State whether the barometer rises or falls in (a) the front; (b) the centre; (c) the rear of a region of low pressure.

Exercise 25. Examine the arrangement of the winds in these maps, and show their directions in various portions of the cyclonic area by the following scheme:—

<i>Area.</i>	<i>Wind Directions.</i>
Front	
Centre.	
Rear	
North	
South	

Exercise 26. What changes in the direction and strength of the wind did the following places experience during the twenty-four hours between the two sets of observations:—S.W. Ireland; London; Dundee; Paris; Hamburg; Stettin?

Exercise 27. On a piece of tracing-paper draw several concentric circles to represent the isobars in a cyclonic area, and print 'LOW' in the centre. Draw arrows to show the normal wind directions in various parts of the area. Place the paper on a map of North-Western Europe so that the centre is to the west of Ireland, and

slowly move it eastward till the centre is in Central Germany.

Observe and record—(a) the changes of pressure, and (b) the changes of wind directions, at Dublin, Aberdeen, Kristiania, London, Bordeaux, and Berlin.

Exercise 28. Compare the temperature conditions as shown on the map for the first day with those as shown for the second day. Describe the change of position of each isotherm, and suggest the reason for each change.

Find places which experienced (a) the greatest increase, (b) the least change, (c) the greatest decrease in temperature. In the first and third cases estimate the amount of the change in degrees, and in each case suggest the reason for the facts observed.

Exercise 29. Examine the weather symbols on the two maps, and describe the weather conditions in the various portions of each system, adopting the same divisions of the cyclonic area as used in Exercise 25.

Assuming the weather conditions on these two days to be typical of those of cyclones generally, state in what parts of a cyclonic area the following conditions might be expected:—Blue sky; detached clouds; overcast sky; steady rain; occasional rain.

Exercise 30. Insert the symbols for these weather conditions on the diagram of a cyclonic area made on tracing-paper (Exercise 27). First put each symbol upon the part of the area appropriate to it as stated in the preceding exercise, and then test this work by referring to Figs. 7 and 8. As before, move the tracing-paper across a map of North-Western Europe, and observe and record the changes of weather at the places mentioned in Exercise 27.

Exercise 31. Imagine that you were in London during the twenty-four hours between the times to which the maps in Figs. 7 and 8 relate. Describe fully the changes that you would notice in regard to the direction of the wind, the force of the wind, the temperature, the rain, and the state of the sky. What change in the barometer would be associated with these changes?

Describe changes that might be expected at Kristiania during the same interval.

Low and High Pressure Systems, or Cyclones and Anticyclones

Exercise 32. Fig. 9 is a weather map for some days later, and shows a very different system of pressures and winds. This system is known as a high pressure system or anticyclone. Describe the arrangement of the pressures, and suggest a reason for the use of the term anticyclone.

Examine the wind symbols in Fig. 9, and from the facts there shown test the rule connecting the barometric gradient with the direction of the wind in regard to the two points: (1) whether the winds blow from high to low pressure; (2) whether they are deflected to the right of a line drawn directly down the barometric gradient.

Exercise 33. Assuming that the conditions shown in Fig. 9 are typical of an anticyclone, compare cyclones and anticyclones in regard to the following points: (1) the steepness of the gradients and the force of the winds in the two systems, observing particularly the number of symbols on the maps indicating strong winds

and calms respectively; (2) the general direction of the winds, whether clockwise or counter-clockwise.

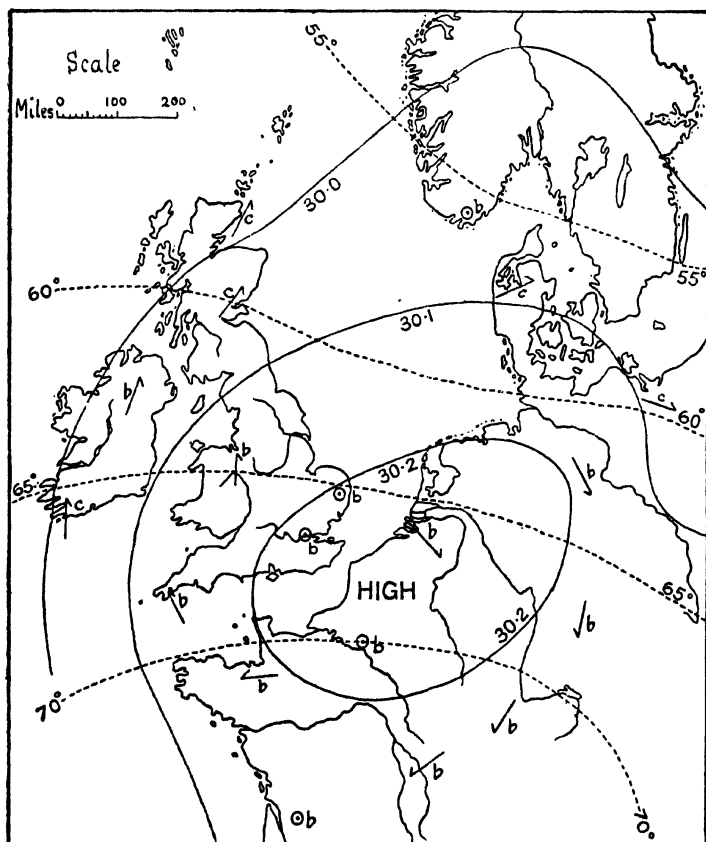


FIG. 9. Weather Map showing Anticyclonic Conditions.

Exercise 34. Similarly compare the state of the sky in cyclones and anticyclones. Bearing in mind the difference of air pressure, and also the conclusions reached

in Exercise 31, suggest rules connecting the height of the barometer with the state of the sky.

Exercise 35. Describe and account for the arrangement of the isotherms in Fig. 9. (The high temperatures shown here are characteristic of anticyclones in summer only; in winter the temperatures are reduced below the normal by anticyclonic conditions.)

Exercise 36. The chart of mean daily pressures shown in Fig. 4 referred to the south of England, and the cyclonic conditions shown in Figs. 7 and 8 existed on the first and second days of the month. Verify this statement by comparing the barometric readings in the south of England as shown on the chart and the maps. The anticyclonic conditions shown in Fig. 9 existed on the tenth day of the month; verify this statement similarly.

Examine Fig. 4 and find for what length of time the anticyclone remained over North-Western Europe.

Exercise 37. It is characteristic of anticyclones that they do not move away quickly, but frequently remain for some time with very little change. Examine Fig. 4 and suggest the first day after the tenth on which the weather map changed considerably.

On what days of the month did a region of low pressure pass over the south of England?

How many well-marked cyclones and anticyclones respectively were experienced during the month? Which type of weather was more frequent? Which type was more enduring?

Exercise 38. Contrast cyclones and anticyclones, arranging the answer as follows:—

- I. Pressures—Arrangement of high and low.
Average height of barometer.
Steepness of gradient.

2. Winds — Force.

Direction with regard to centre.

Direction compared with the hands of a watch.

3. Weather — Rain.

State of sky.

Exercise 39. Examine one of the cyclone maps. Imagine yourself standing at any one of the stations with your back to the wind, i.e. looking in the direction toward which the arrow points. Find in what direction with regard to you (e.g. before, behind, to the right, to the left) the lowest pressure is situated.

Imagine yourself standing at another station in another part of the area, and again find the direction of the lowest pressure when you stand with your back to the wind.

Repeat these observations on the other cyclonic map and then on the anticyclonic map.

A law called Buys Ballot's Law is frequently stated thus: 'Stand with your back to the wind and the lowest barometer lies to the left.' Do the last three words express quite accurately the result you obtained? Can you suggest an amendment?

The Use of Combined Weather Charts

Exercise 40. Keep a combined record of all the factors relating to weather conditions, i.e. pressures, temperature, rainfall, wind direction, wind force, state of the sky, and amount of sunshine¹. Compare daily your

¹ A large and strong 'Combined Weather Chart', ruled for the recording of each of these factors for one month, and giving instructions as to the best methods of making the records, will shortly be published by the Clarendon Press.

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observations with those of the nearest meteorological station as given on the Daily Weather Report of the Meteorological Office, and try to account for any differences there may be.

Enter any unusual effects of weather conditions (see Exercise 45) in the space for notes, giving the date in each case.

Exercise 41. When the barometer begins to fall, watch for the approach of a cyclone and record the changes that take place as the centre becomes nearer. Similarly observe the changes that ensue as the centre passes away.

When the barometer rises above 30 inches and remains above this level, examine the map in the Daily Weather Report to see if there is a general anticyclonic system. Observe the weather conditions and see how long each factor remains without substantial change.

Exercise 42. At the end of the month, look along the line showing the pressure changes, and notice at what dates a markedly low pressure was indicated. Take each date separately, and look down the column and see whether the other factors indicate a typical cyclone. Find on how many occasions this was the case, and on how many occasions there was exceptional weather. Try to account for such exceptions with the aid of the map in the Daily Weather Report.

Exercise 43. At the end of twelve months count up the total number of cyclones and anticyclones experienced, and calculate the average duration of the low and high pressure systems respectively.

Exercise 44. Review the anticyclones, and find at what dates they were associated with temperatures higher than the average for the month, and at what

dates they were associated with temperatures lower than the average for the month. Do your results confirm the statement made in Exercise 35 that in summer anticyclones bring exceptionally hot weather, while in winter they bring exceptionally cold weather?

Exercise 45. Find at what portions of the year cyclones were most frequent. Did their frequency cause conditions that were serious, e.g. the failure of a harvest? Was the weather or its results the subject of special comment in the newspapers at times when there was a quick succession of cyclones?

Had the anticyclones any extraordinary effects, e.g. the exhaustion of water supplies in towns or the freezing of the rivers? Explain any such occurrence.

THE WORLD AS A GLOBE

The Shape of the Earth

Exercise 46. Take a globe as large as possible and observe whether the surface at every point is flat or curved. Lay a flat round piece of stiff cardboard at any point upon it; does the card fit to the surface exactly? Lay a smaller piece of card upon the globe; does this seem to fit more exactly to the surface? Lay a very small piece of card, no more than $\frac{1}{4}$ of an inch in diameter, upon the globe; does this seem to fit more exactly to the surface? Does the portion of the surface covered by the small piece of cardboard differ appreciably from a flat surface?

Do the surface of the ground, apart from the hills and valleys, and the surface of the sea seem to us to be flat or curved?

Compare the diameter of your very small piece of cardboard with the circumference of the globe. If from a lighthouse we can see 12 miles on each side of us, and people have travelled over 24,000 miles in going round the world, can we see a larger proportion of the Earth than the proportion of the globe covered by the small piece of cardboard?

Exercise 47. Take a strip of strong cardboard, at least 2 feet long, and through it put a row of nails each 3 inches high. Look along the row of nails when the card is flat; what do you observe about them? Bend the card slightly, and again look along the row; describe the appearance of the successive nails as they are seen over this curved surface.

If one looks at a number of ships on the sea in any part of the world, a ship that is near may be seen down as far as the water-line; one farther off has the hull invisible, but the masts can clearly be seen; one still farther off has only the tops of the masts visible, and if one looks through a telescope one sees the tops of the masts apparently standing out of the water; still farther off a steamship may be quite invisible although the smoke above the funnel may be quite clearly seen through a telescope.

Compare the appearance of the ships with the appearance of the nails, and state the conclusion which this suggests regarding the surface of the Earth.

Exercise 48. By these and other observations the surface of the Earth has been found to be curved at every point. What objects of different shapes have their surfaces curved at every point? Take such of these objects as you can, and throw their shadows upon a screen; move the objects round, observe and describe

the outline of their shadows in the successive positions. What is the shape of the body that in every position has a shadow with a circular outline?

When the Earth is between the Sun and the Moon, the shadow of the Earth is thrown upon the Moon; this is known as an eclipse of the Moon. The eclipse of the Moon occurs sometimes when one portion of the Earth is opposite to the Moon, and at other times when other portions of the Earth are opposite to the Moon, or else different eclipses would not be visible in different parts of the Earth; but in every case the outline of the shadow is circular. What does this fact show regarding the shape of the Earth?

The Rotation of the Earth

Exercise 49. Refer to the records of the daily movements of the Sun, noting particularly its apparent movement round the Earth and its direction in the morning, at noon, and in the afternoon.

Experiment with a globe to represent the Earth, and a lamp (or some other object) to represent the Sun. At a place on the globe corresponding to the position of Britain on the Earth, fasten a toy soldier standing on the globe and facing south. (This may be done by securing a broad elastic band to the stand of the soldier and passing the band around the globe.)

First keep the globe stationary, and move the lamp around it from east to west. When the lamp comes round the globe to the side on which the soldier is standing, observe on which side of him the lamp would appear to him to be. As the lamp continues its course observe whether it passes in front of him or behind him;

when the lamp passes around to the other side of the globe, observe on which side of him it is just before it disappears. State how the soldier would describe the successive directions of the lamp, using the names of the points of the compass. Would his descriptions agree with your observations of the directions of the Sun? Would the theory of the Earth being stationary, and the Sun revolving around it, explain the facts as you have observed them?

Next keep the lamp stationary and rotate the globe on its axis *from east to west*, having the soldier fixed as before. When the globe has rotated so that the soldier comes round to a place from which he could just see the lamp, observe on which side of him the lamp would appear to him to be. As the Earth continues its rotation, observe whether he would see the lamp pass in front of him or behind him, and when it has rotated so that he passes out of sight of the lamp, observe on which side of him it is just before it disappears. State again how the soldier would describe the successive directions of the lamp, using the names of the points of the compass. Would his description agree with your observations of the directions of the Sun? Would the theory of the Sun being stationary, and the Earth rotating on its axis *from east to west*, explain the facts as you have observed them?

Again keep the lamp stationary, and rotate the globe *from west to east*. Repeat the experiment with the rotation in this new direction, and describe the successive positions of the lamp as the soldier would observe them. Would the theory of the Sun being stationary, and the Earth rotating on its axis *from west to east*, explain the facts actually observed?

Exercise 50. To decide which of the two possible

theories is the correct one, it is necessary to find from other evidence whether the Earth rotates or whether it does not.

Obtain a large wooden disc, and upon opposite edges fix two upright pieces of wood with a cross-piece resting upon them. Bore a hole through the centre of this cross-piece and through it pass a string, so that it hangs just over the centre of the board. At the end of the string fasten a small heavy ball, and carefully swing this pendulum, noticing the direction of the swing with regard to the framework and also with regard to the room. Does the direction of the swing change as the width of the swing becomes less?

Again swing the pendulum and notice the direction of the swing as before, but while the pendulum is still strongly swinging gently turn the disc and framework. Does the direction of the swing change with regard to the framework? Does it change with regard to the room? What does this experiment teach regarding the direction of the swing of a pendulum while the supports and the surroundings change their position?

Hang a long thin wire (by an attachment such as that shown in Fig. 10) from the highest possible point in a room free from draughts, and at the end fix a heavy ball. Draw the pendulum to one side and fasten it with a piece of thread. Burn the thread in order to let the pendulum commence its swing without any twist, and note the direction of the swing. Does the direction of the swing remain the same with reference to the room?

Bearing in mind the conclusion drawn from the previous experiment, state what this last result teaches with regard to the room, and therefore the whole building and the Earth itself.

State the theory which explains both the experiment with the pendulum and the apparent movements of the Sun.

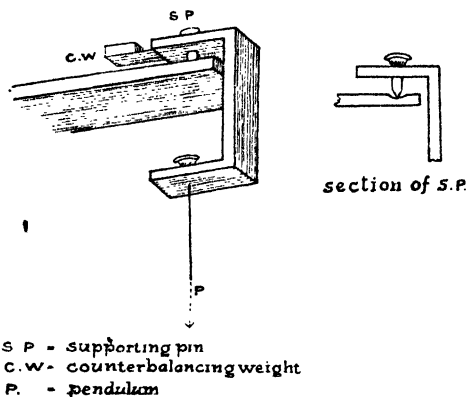


FIG. 10. Diagram showing Attachment of the Pendulum proving the Rotation of the Earth.

Longitude

Exercise 51. On a globe covered with slate-cloth draw two circles passing through the two poles, and dividing the distance around the globe into four equal parts. Draw two more circles through the poles midway between those already drawn, and note into how many parts the distance around the globe is now divided. Other circles could be drawn similarly until the distance around the globe would be divided into 360 parts.

The distance measured east and west from any one of these lines to the next would then be one degree of any circle round the globe. How many degrees are there from one of the lines you have actually drawn on the globe to the next one? Is the length of a degree the same at

every part of the globe? Where is it greatest and where is it least?

Such lines are imagined to exist on the Earth, and are called meridians of longitude; the space between one meridian and the next is called one degree of longitude. Is the length of one degree of longitude the same at every part of the Earth? If the distance around the Earth at the equator is 24,900 miles, what is the length of one degree of longitude at the equator? What is the length of one degree of longitude at the poles?

Exercise 52. Let the light from a lamp fall upon a globe in an otherwise dark room. Observe how much of the globe is lit up and how much is dark. Rotate the globe from west to east, and note the boundary between the light and the dark. Record the direction (from east to west, *or* from west to east) in which the boundary moves across the globe.

If the globe represents the Earth and the lamp represents the Sun, what does this experiment teach with regard to movement of daylight round the Earth?

If the Sun apparently moves round the World and returns to the same position in 24 hours, how long does it take for the Earth to rotate once on its axis, and therefore for daylight to move completely round the Earth?

Exercise 53. The position of a place can be fixed by knowing two facts concerning it: (1) Its latitude, or distance north or south of the equator; (2) its longitude, or distance east or west of a given meridian. The latter distance is measured by the number of degrees counted east or west from the meridian which passes through Greenwich.

This number of degrees may be found by comparing

the time at which daylight reaches Greenwich and the time at which daylight reaches the place in question. If daylight passes entirely round the Earth in twenty-four hours, how long will it take to pass from one meridian to the next, i. e. to pass through one degree of longitude?

If it is observed that a certain place has daylight before Greenwich, is the place to the east or to the west of Greenwich? If the place has daylight two hours before Greenwich, how many degrees of longitude is it from the meridian of Greenwich?

State the longitude of the place in the following form:
'Longitude ° E. (*or* W.) of Greenwich.'

Exercise 54. Sailors ascertain the longitude of a place in the following way. First they find when it is midday by observing the Sun, and then they compare this with the time as reckoned at Greenwich. This they do by taking with them a chronometer which shows Greenwich time throughout a voyage. If they see that they have noon before the chronometer shows noon, has the Sun reached their part of the World first or has it reached Greenwich first?

If they find that they have noon before Greenwich has noon, are they east of Greenwich or west of Greenwich?

If they find that they have noon when the chronometer shows Greenwich time to be 10 a.m., what is the longitude?

Exercise 55. A sailor observes that when the Sun has reached its highest point, the chronometer reads 30 minutes p.m. What is his longitude?

Exercise 56. A telegram dispatched from London at 9 a.m. has its time of arrival at a certain place recorded as 2.12 p.m. Assuming that no time is taken by transmission, find the longitude of the place of arrival.

Exercise 57. Find from the atlas the longitude of New Orleans. What time has New Orleans when Greenwich has noon? What time has Greenwich when New Orleans has noon?

Exercise 58. A telegram was dispatched from Dublin at 11.30 a.m. At what time was its arrival at Madras recorded if 20 minutes were occupied in transmission?

The Inclination of the Earth's Axis

Exercise 59. Experiment with a globe to represent the Earth and a lamp to represent the Sun. Place the globe so that the north end of the axis points directly to the lamp, and notice that the axis now lies in the line joining the globe and lamp. Rotate the globe, and observe whether the Northern Hemisphere has an alternation of light and darkness as the globe rotates. Do the conditions as to daylight on this globe agree with those which we observe on the Earth? Is it possible for the axis of the Earth to be in this position at any time of the year?

Place the globe so that the north end of the axis points directly away from the lamp, and notice that the axis again lies in the line joining the globe and lamp. Rotate the globe, and again observe the conditions as to light and darkness in the Northern Hemisphere. Do the conditions agree with those which we observe on the Earth? Is it possible for the axis of the Earth to be in this position at any time of the year?

Exercise 60. Place the globe so that the axis is vertical and at right angles to the line joining the globe and lamp. Rotate the globe, and notice whether there is

an alternation of light and darkness in the Northern Hemisphere. Place a mark on the globe in such a position that it indicates the position of Britain on the Earth. Watch the mark as the globe rotates, and observe during what proportion of the rotation the mark is in the light and during what proportion of the rotation it is in the darkness. If the rotation took twenty-four hours, how long would the periods of light and darkness last respectively?

Tilt the globe so that the axis is inclined slightly from the vertical and yet remains at right angles to the line joining the globe and lamp, i. e. so that neither pole is nearer to the lamp than the other. Rotate the globe, and repeat the above observations. If the rotation took twenty-four hours, how long would the periods of light and darkness last at a place in the position of Britain?

Do the facts as to the light and darkness actually observed in Britain ever correspond with the results of these experiments? At what periods of the year is it possible that the axis of the Earth is at right angles to the line joining the Earth and Sun?

Exercise 61. Place the globe so that the axis is slightly inclined to the line joining the globe and lamp, with the north pole nearer to the lamp than the south pole. Rotate the globe, and observe how long the mark in the position of Britain is in the darkness and how long in the light.

Are these relative amounts of light and darkness ever experienced in Britain? At what period of the year is it possible that the axis of the Earth is inclined to the line joining the Earth and Sun, with the north pole nearer the Sun?

Exercise 62. Place the globe so that the axis is

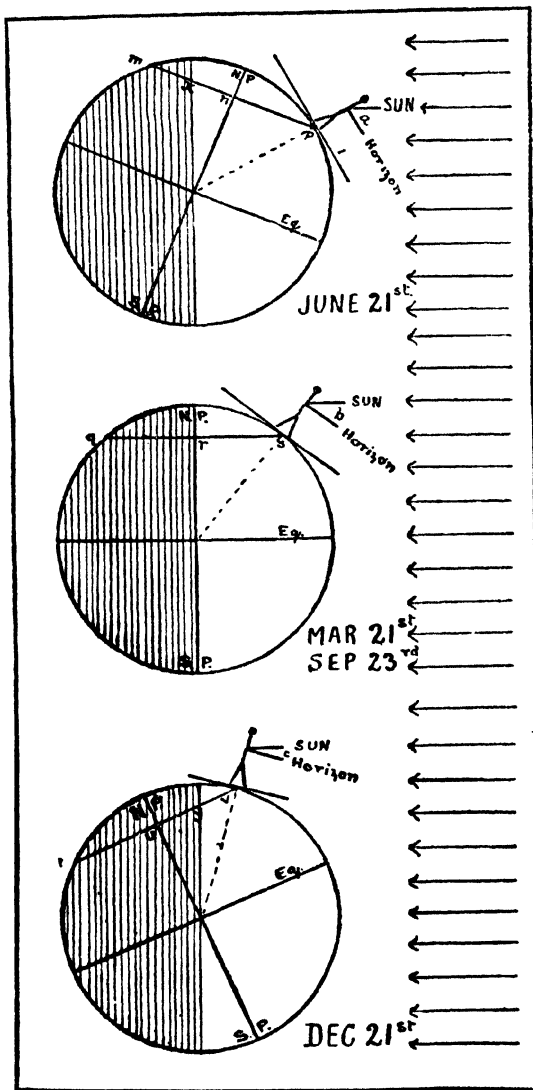


FIG. 11. Diagrams showing the effects of the Inclination of the Earth's Axis on the Length of the Day and the Altitude of the Sun.

slightly inclined to the line joining the globe and lamp, but with the north pole farther away from the lamp than the south pole. Rotate the globe, repeat the observations, and state at what period of the year it is possible that the north pole of the Earth is farther from the Sun than the south pole.

Exercise 63. State the facts as to the varying lengths of day and night in Britain at different periods of the year, and show how these facts may be explained by the theory that the Earth's axis changes its position with regard to the line joining the centres of the Earth and the Sun. Copy the portions of Fig. 11 that refer to the varying lengths of day and night, and use the diagrams and the lettering upon it to make your explanation clear.

Exercise 64. Fig. 11 shows not only the changes in the length of light and darkness, but also the changes in the altitude of the midday Sun during the year. In each portion of the diagram the figure has one arm pointing towards the Sun and the other pointing towards the horizon. Carefully trace the angles made by the two arms, prolong the lines, and find the altitude of the Sun at each period of the year.

Do these heights correspond to those you observed when working the exercises in Part I? (There may be *slight* differences due to the fact that the diagram relates to an observer in the neighbourhood of London.) Does the theory that the Earth's axis changes its position with regard to the line joining the Earth and Sun explain the changes in the midday altitude of the Sun?

Measure the angles in the diagram, and state the amount of the inclination of the axis at each season.

The Revolution of the Earth

Exercise 65. Find the altitude of the Pole Star by looking at it along the edge of a clinometer and reading the number of degrees that the clinometer is inclined from the horizontal. Repeat the observation an hour or two later. Similarly measure the altitudes of some other easily distinguished stars and compare your results. What fact do you observe regarding the position of the Pole Star?

Measure the altitude of the Pole Star once a week for a number of weeks. State the conclusion you draw regarding the altitude of the Pole Star.

Exercise 66. Let a lamp represent the Sun, a globe represent the Earth, and a certain spot in the ceiling of the room represent the Pole Star. Place these three objects in such a position that they show how the northern end of the axis is inclined to the Sun (as shown for June 21 in Fig. 11) while at the same time it points directly to the Pole Star.

Place a small disc of cardboard on the globe where Britain would be on the Earth, so that the disc may represent the apparently level ground in Britain. Place one end of a pencil on the centre of the disc and point the other end to the spot representing the Pole Star. Measure the angle at which the pencil is inclined to the disc; does it agree with your observations of the altitude of the Pole Star?

Without moving the globe as a whole alter the inclination of the axis so that it is at right angles to the line joining the lamp and globe. Point the pencil as before to the spot representing the Pole Star, and measure the angle at which the pencil is inclined to the disc; does it agree with your observations of the altitude of the Pole Star?

Again, without moving the globe as a whole alter the inclination of the axis so that the northern end is inclined away from the lamp. As before point the pencil to the spot representing the Pole Star and measure the angle obtained. Does it now agree with your observations of the altitude of the Pole Star?

Exercise 67. State whether the theory of the axis of the Earth changing its inclination in this manner agrees with the known facts as regards :—

1. The changing length of the day ;
2. The changing midday altitude of the Sun ;
3. The unchanging altitude of the Pole Star.

Is the theory correct or incorrect ?

Exercise 68. Place the globe and lamp as described in the first part of Exercise 66 and shown in the left-hand position in Fig. 12. Does this arrangement of the three bodies agree with *all* the observations relating to June 21?

Now move the globe one quarter of the way around the lamp, keeping the axis inclined so that the northern end of the axis still points to the spot representing the Pole Star. (See lower position in Fig. 12.) Observe that the axis is now at right angles to the line joining the lamp and globe. Does this arrangement of the three bodies agree with *all* the observations relating to September 23?

Move the globe another quarter of the way round the lamp, still keeping the axis inclined so that the northern end of the axis points to the spot representing the Pole Star. Observe that the northern end of the axis is now farther from the lamp than the southern end. Does this arrangement of the three bodies agree with *all* the observations relating to December 21?

Move the globe another quarter of the way round the lamp, keeping the axis parallel to its former positions. Does this arrangement of the three bodies agree with *all* the observations relating to March 21?

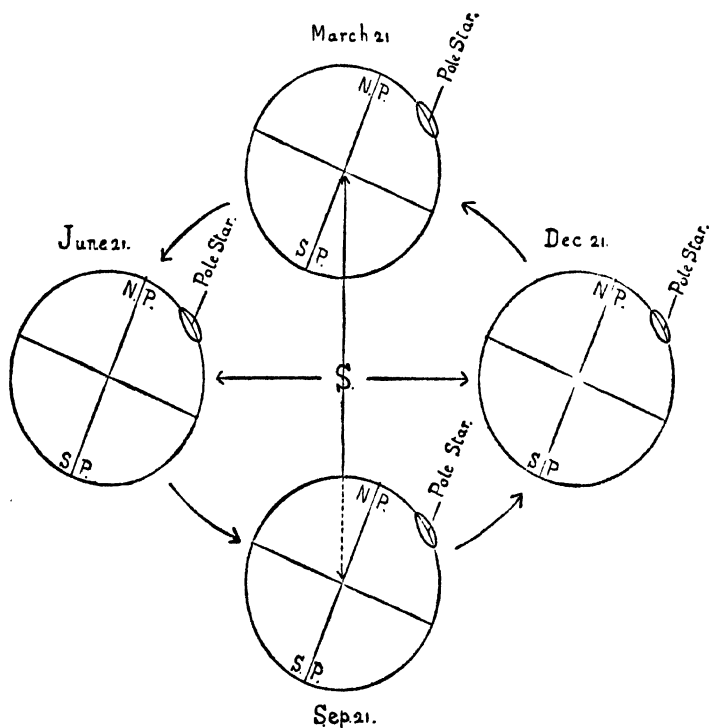


FIG. 12. Experiment Illustrating Revolution of Earth round Sun.

Exercise 69. Describe this revolution of the globe around the lamp, mentioning with special care the successive positions of the axis.

Would a theory of the Earth annually revolving

around the Sun in this manner agree with the known facts as regards:—

1. The changing length of the day ;
2. The changing midday altitude of the Sun ;
3. The unchanging altitude of the Pole Star ?

Exercise 70. State briefly what has been ascertained about (*a*) the rotation, (*b*) the revolution of the Earth, and say in what ways these two movements differ.

Exercise 71. Place the globe and lamp so as to represent the position of the Earth in December. Rotate the globe, and find the length of the day in Britain. From this deduce the times of sunrise and sunset.

Place the cardboard disc at the position of Britain, point the pencil to the Sun and find the midday altitude of the Sun.

What do you deduce as to the duration and the intensity of the heat received in Britain in December ?

Make similar observations and deductions regarding the sunlight and heat at a place on the globe exactly opposite to the first, and therefore nearly representing the position of New Zealand.

Exercise 72. Place the globe and lamp so as to represent the position of the Earth in June.

State what you observe and deduce regarding the length of day, the times of sunrise and sunset, the mid-day altitude of the Sun, and the duration and intensity of the heat received in Britain in June.

Make similar statements regarding the conditions in New Zealand.

Exercise 73. Describe briefly the changes experienced in regard to sunlight and heat in New Zealand from January to December, and state how they differ from the changes experienced in Britain during the same period.

Latitude

Exercise 74. Take a globe covered with slate-cloth to represent the Earth and on it mark the equator and a circle passing through the two poles. Divide each quarter of this circle into nine equal parts. Through the first marks north of the equator draw a circle parallel to the equator. Since at all points this line marks the same distance from the equator, i.e. the same latitude, it is called a parallel of latitude. Draw similar parallels through the other points. Imagine that each of the spaces between these parallels (including the equator as one) were divided into ten equal parts; each of these small spaces would represent one degree of latitude.

How many degrees of latitude are there in (a) the spaces between the parallels you have actually drawn; (b) the space between the equator and the north pole; (c) the whole length of the circle crossing the equator and passing through the two poles?

A place that is one degree north of the equator is said to be in latitude 1° N., and similarly a place that is one degree south of the equator is said to be in latitude 1° S. If a place is on the first parallel you have drawn north of the equator, what is the latitude of the place? What is the latitude of the south pole? What is the latitude of a point half-way from the equator to the north pole? Refer to an atlas and state the latitude of London, New Orleans, Madras, and Melbourne.

Exercise 75. At places near the equator the Pole Star is observed to be low in the sky. At Colombo in Ceylon it is found to be a little less than 7° above the horizon. Find from the atlas the latitude of Colombo.

At Rome the altitude of the Pole Star is nearly 42° . Find from the atlas the latitude of Rome.

What is the altitude of the Pole Star in your district according to your own observations? Find from the atlas the latitude of your district.

The Pole Star is so named because it is overhead at the north pole. What is its altitude at the north pole? What is the latitude of the north pole?

Compare the above facts and suggest a way in which a sailor may find the latitude of any place at which he may be.

Exercise 76. Fig. 13 explains why the altitude of the Pole Star indicates the latitude.

Let C represent a place at the equator and CD a line drawn from the equator to the centre of the Earth; the latitude of C is obviously 0° . Let B represent a place in latitude 60° N.; then BD represents a line drawn from B to the centre of the Earth, and the latitude of B is shown by the angle BDC , which is 60° . Let A represent the north pole; then AD represents a line drawn from A to the centre of the Earth, and the latitude of A is shown by the angle ADC , which is 90° . If DA is continued to E , DB to F , and DC to G , these lines show the directions of the zenith at A , B , and C , respectively. (The zenith is the part of the sky which is directly overhead.)

The arrow-headed lines AE , BH , and CJ each point to the Pole Star, which is so far away that these lines may be considered parallel. The short lines KL , MN , and PQ show the 'ground line' at A , B , and C , respectively, and may be taken as pointing to the horizon at each place.

It is apparent that at C , where the Pole Star would be

observed on the horizon, its altitude is 0° , and also that the latitude is 0° .

At *A*, where the Pole Star is observed to be overhead,

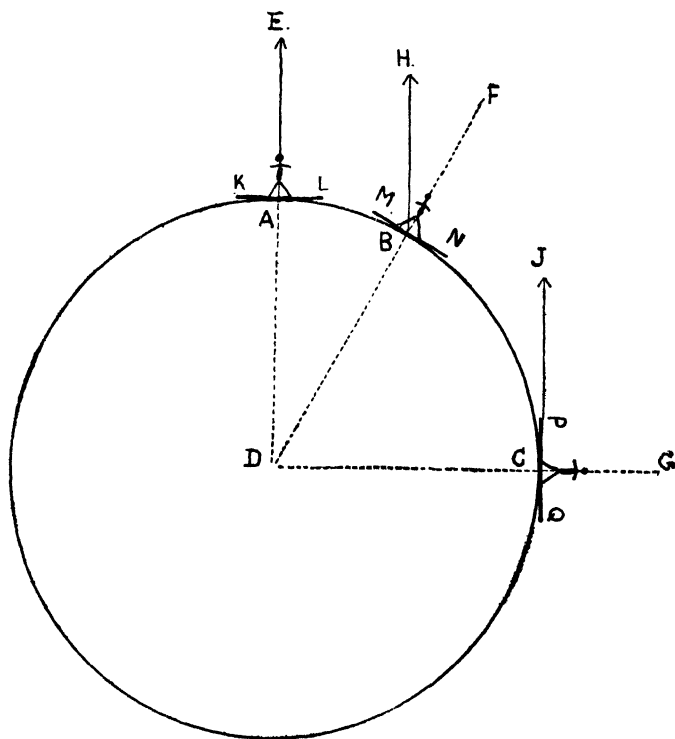


FIG. 13. Diagram showing why the Altitude of the Pole Star indicates the Latitude.

its altitude is 90° , and the latitude is shown by the angle *ADC* to be 90° . At *B*, where the altitude of the Pole Star is 60° , the latitude is 60° , and therefore the angle *BDC* is 60° .

Draw a similar diagram showing the altitude of the Pole Star at latitude 30° N., and also at the latitude of your own district.

Bearing in mind that the lines DE and BH are parallel, and that the line DF intersects them, prove by geometry that the angle MBH equals the angle BDC .

Exercise 77. Fig. 14 shows how the latitude of a place may be found by observing the Sun when it is in the south and highest in the sky. In each diagram A represents the place, C the centre of the Earth, E the equator, Z the zenith or point immediately overhead at the place considered, and the lines AS and CS show the direction of the Sun.

On March 21 and September 23 the axis of the Earth is at right angles to the line joining the Earth and Sun, and therefore the number of degrees between the highest position of the Sun and the zenith is equal to the number of the degrees in the latitude of the place (angle ZAS = angle ACE).

On June 21 the northern end of the axis is inclined $23\frac{1}{2}^{\circ}$ towards the Sun; the line joining the centre of the Earth to the Sun therefore passes $23\frac{1}{2}^{\circ}$ north of the equator. (Angle TCE is $23\frac{1}{2}^{\circ}$.) On this day the Sun is said to have a north declination of $23\frac{1}{2}^{\circ}$. The latitude is shown by the angle ACE , and this is the sum of the angles ACT and TCE . Since the angle ACT equals the angle ZAS , the angle ACE equals the sum of the angles ZAS and TCE . Therefore the latitude of a place in the Northern Hemisphere may be found by adding the degrees between the highest position of the Sun and the zenith to the degrees in the north declination of the Sun. The declination of the Sun constantly changes, but the amount for each day is given in the *Nautical*

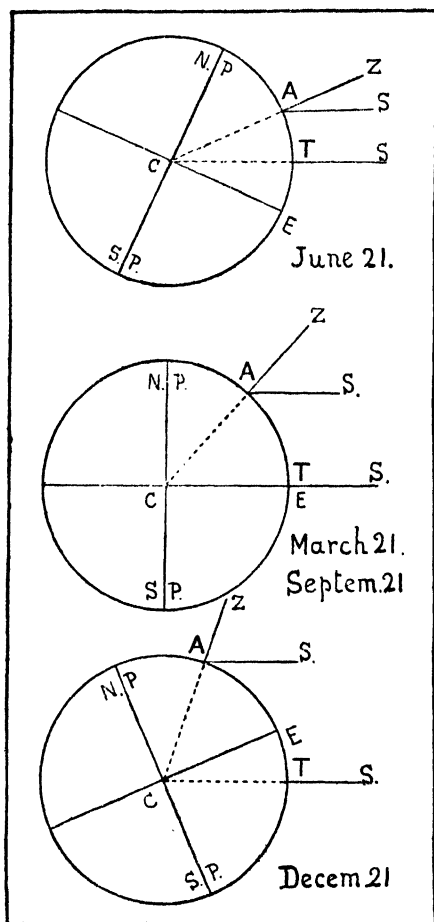


FIG. 14. Diagrams showing how Latitude may be found by Observation of the Sun.

Almanac prepared especially for the use of sailors. (It is also given with less accuracy in *Whitaker's Almanac*.)

Thus on any day from March 21 to September 23 the latitude is found by adding the north declination of the Sun to its distance from the zenith when highest in the sky.

On December 21 the angle ECT is $23\frac{1}{2}^{\circ}$, and therefore the Sun has a south declination of $23\frac{1}{2}^{\circ}$. The latitude is shown by the angle ACE , and this equals the angle ACT less the angle ECT . But the angle ACT equals the angle ZAS , which is the distance of the Sun from the zenith. Therefore the latitude is equal to the distance of the Sun from the zenith less its south declination.

Thus on any day from September 23 to March 21 the latitude is found by subtracting the south declination of the Sun from its distance from the zenith when highest in the sky. (Observe that the rules as to addition and subtraction of the Sun's declination must be modified if the place is in the Southern Hemisphere.)

Draw diagrams showing the conditions about the middle of August and the middle of November, and relating to a place in the latitude of Edinburgh.

Exercise 78. The declination of the Sun is 8° S. on Oct. 14. Draw a diagram representing the conditions on that day, and from the diagram ascertain the greatest height of the Sun as observed in your latitude on that day.

Exercise 79. A sailor in the Northern Hemisphere observes that the Sun is $49^{\circ} 40'$ from the zenith when it is in the south. He finds from the *Nautical Almanac* that the Sun has a north declination of $4^{\circ} 13'$. Find to what periods of the year this declination might refer and calculate the latitude.

THE PRINCIPAL COUNTRIES

France

AREAS AND POPULATIONS OF THE BRITISH ISLES AND
FRANCE (*in 1921*)

<i>Region</i>	<i>British Isles</i>	<i>France</i>
Square Miles	121,000	213,000
Persons	47,000,000	40,000,000

Exercise 80. Construct diagrams comparing the areas, populations, and densities of population of the British Isles and France, allowing an area of one square inch for every 100,000 square miles, and putting one dot for every 1,000,000 persons. State the differences between the two countries with regard to the total population and the density of population.

Measure on the maps in an atlas the greatest north-and-south and east-and-west lengths of the countries, and compare these lengths. Examine the maps and state why there is a great difference in the areas of the two regions, whereas there is little difference in their lengths.

Exercise 81. Examine a map showing the relief of the country, and describe the position of (a) the highlands, (b) the lowlands, (c) the passages between or through the highlands. (Consider not only the highlands and lowlands which are entirely within the country, but also those on its borders.)

MEAN MONTHLY TEMPERATURES

($^{\circ}\text{F.}$, i. e. *Degrees Fahrenheit*)

	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Paris	154	36.2	38.5	42.7	49.8	55.3	61.7
Bordeaux	243	40.7	43.0	47.0	53.0	58.3	64.3
Marseille	246	43.3	45.2	48.3	54.8	60.8	68.0
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Paris	65.0	63.8	58.5	50.2	42.5	36.8	50.0
Bordeaux	68.2	68.2	63.7	55.2	46.7	41.2	54.3
Marseille	72.7	71.7	66.2	58.2	49.8	44.0	57.0

Exercise 82. Construct a diagram (as in Fig. 17) showing the mean monthly temperatures at these places. (To distinguish them clearly use three different colours for the connecting lines.)

MEAN MONTHLY RAINFALL. (*Inches*)

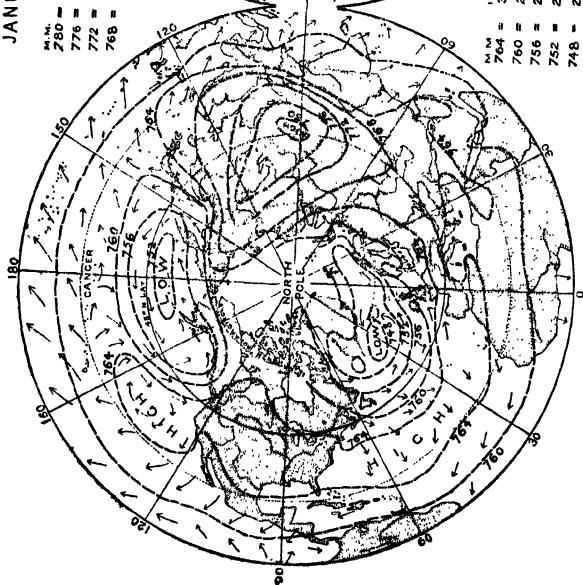
	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Paris	154	1.4	1.3	1.5	1.7	1.8	2.1
Bordeaux	243	2.8	2.3	2.5	2.6	2.9	3.2
Marseille	246	1.9	1.4	1.8	2.0	1.6	1.0
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Paris	2.0	2.1	2.0	2.4	1.8	1.8	21.9
Bordeaux	2.0	2.2	2.6	3.7	3.7	2.9	33.4
Marseille	0.5	1.0	2.4	3.5	3.0	2.2	22.3

Exercise 83. Construct diagrams (as in Fig. 18) showing the mean monthly rainfall at these places. (Note that the three sets cannot clearly be shown on the same diagram because of the shading, but all the diagrams must be on the same scale.)

Exercise 84. Examine the positions of these places, particularly noting the following points: (a) the latitude; (b) the distances from the great water-areas; (c) the

JANUARY

INCHES
 780 = 30.71
 776 = 30.55
 772 = 30.39
 768 = 30.24



INCHES
 764 = 30.08
 760 = 29.92
 756 = 29.76
 752 = 29.61
 748 = 29.45

FIG. 15. Map showing Prevailing Winds in January.

JULY

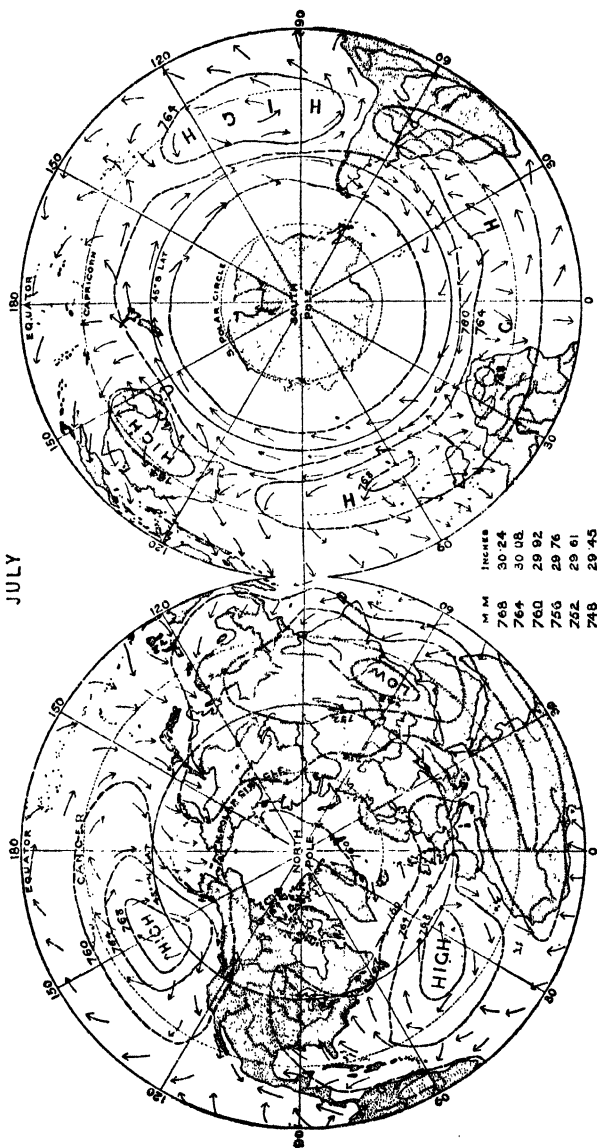


FIG. 16. Map showing Prevailing Winds in July.

direction of the prevailing winds in summer and winter. (See Figs. 15 and 16.) Bearing in mind these differences in the positions of the places, explain the differences in the temperature and rainfall graphs.

PRODUCTION OF WINE. (*Average of recent years*)

France	...	...	...	1,500	million	gallons.
Italy	...	...	...	1,000	"	"
Spain	...	...	...	500	"	"
Germany	...	...	...	25	"	"

Exercise 85. Draw a series of rectangles showing the relative importance of the above countries in the production of wine.

From the table given above and other tables given in the section on the United States, state what is the importance of France relatively to other countries in the production of wine, wheat, coal, and iron respectively.

FOREIGN TRADE OF FRANCE

(*Average of recent years*)

[*Value in millions of £*]

IMPORTS, 396: including Raw Wool, 36; Raw Cotton, 30; Coal and Coke, 24; Raw Silk, 19; Oil Seeds, 18; Mineral Oils, 15.

EXPORTS, 396: including Machinery and Metal Goods, 32; Silk Goods, 30; Cotton Goods, 22; Iron and Steel, 20; Apparel, 19.

Exercise 86. Construct a diagram showing the amount and nature of the import trade of France. Use squared paper and draw to the scale of 1 square inch to each £10,000,000 of trade. First draw a large figure for the total import trade. Cut off from this an area of 3.6 square inches to represent the value of the trade in wool, and write the word 'wool' in this area. Similarly show the value of the trade in the other imported

commodities. By the same method and on the same scale show the amount of the export trade.

Contrast these diagrams with those made to show the trade of the United Kingdom (Part I, Exercises 363 and 364), and state the differences with regard to the total imports, the total exports, and each commodity given in the table above.

CHIEF TOWNS. (*Populations in 1926*)

Paris	...	...	...	2,870,000 persons.
Marseille	...	...	...	650,000 „
Lyon	...	...	...	570,000 „
Bordeaux	...	...	...	260,000 „

[*Note.* In this and the following tables only towns with populations exceeding 250,000 persons are given, except in the case of capitals.]

Exercise 87. Draw a series of rectangles to represent the relative size of these centres, using the same scale as for the cities of the United Kingdom, i. e. 1 square inch for every 250,000 persons. In each rectangle write the name of the centre with the occupations that are largely carried on at that centre.

Examine the map and state the advantages of position which each centre possesses.

Germany

AREA AND POPULATION (*in 1925*)

Area	...	...	...	181,000 square miles.
Population	...	...	...	63,000,000 persons.

Exercise 88. Draw diagrams showing the area, population, and density of population, according to the directions in Exercise 80.

Exercise 89. Examine a map showing the relief of

the country, and describe the position of (a) the highlands, (b) the lowlands, (c) the passes between or through the highlands. (Consider not only the highlands and lowlands which are entirely within the country, but also those on its borders.)

MEAN MONTHLY TEMPERATURES AND RAINFALL AT
BERLIN. (*Height above sea-level 131 feet*)

	Jan.	Feb.	Mar.	Apr.	May	June	
Temp. (°F.)	30.3	32.5	37.2	45.8	54.8	62.0	
Rain (inches)	1.5	1.5	1.8	1.4	1.7	2.5	
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year.
Temp. (°F.)	64.5	63.3	57.0	48.2	38.5	33.2	47.3
Rain (inches)	2.7	2.2	1.7	2.0	1.8	1.9	22.7

Exercise 90. Construct diagrams to show these temperature and rainfall conditions. Examine the position of Berlin and notice the direction of the prevailing winds. Compare and contrast the climatic conditions with those of your own district, and account for the similarities and the differences.

Exercise 91. Examine the tables given in the section on the United States, and state the position of Germany relatively to other countries in regard to the production of coal and iron. In what portions of Germany are the greatest amounts of coal and iron produced, and what are the chief towns concerned in these industries?

FOREIGN TRADE OF GERMANY

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 496: including Wheat, 29; Cotton, 28; Wool, 23; Butter and Margarine, 17; Fruit, 16; Barley, 14.

EXPORTS, 490: including Iron and Steel and Machinery, 92; Coal and Coke, 40; Cotton Goods, 21; Paper and Paper Goods, 20; Electric Appliances, 17; Woollen Goods, 15; Leather and Leather Goods, 14.

Exercise 92. Construct diagrams showing the nature and amounts of the foreign trade of Germany, as directed in Exercise 86. Contrast the foreign trade of Germany (*a*) with that of the United Kingdom, and (*b*) with that of France.

CHIEF TOWNS. (*Populations in 1925*)

	persons		persons
Berlin	4,010,000	Hanover	420,000
Hamburg	1,080,000	Nürnberg	390,000
Cologne	700,000	Stuttgart	340,000
Munich	680,000	Chemnitz	330,000
Leipzig	680,000	Dortmund	320,000
Dresden	620,000	Bremen	290,000
Breslau	550,000	Magdeburg	290,000
Essen	470,000	Königsberg	280,000
Frankfort-on-Main ...	460,000	Duisberg	270,000
Düsseldorf	430,000	Stettin	250,000

Exercise 93. Draw diagrams to represent the relative sizes and occupations of these centres, as directed in Exercise 87.

Compare the number of great towns (i. e. those with more than 250,000 inhabitants) in the United Kingdom, France, and Germany.

Consider the reasons why the individual towns have grown great, and then suggest the general causes for the differences between the number of great towns in the three countries. How have these general causes affected the density of population in the regions?

The Low Countries

AREAS AND POPULATIONS (*in 1920*)

	Holland	Belgium
Square miles	13,000	12,000
Persons	7,000,000	7,500,000

Exercise 94. Construct diagrams showing the areas, populations, and densities of population of the two countries according to the directions in Exercise 80. Compare the densities of the population in these two countries, suggesting reasons for the facts observed.

Exercise 95. Examine an orographical map of Holland and Belgium and compare and contrast the two countries in each of the following respects: coast, position, neighbouring States, height of ground, rivers. In each case show how the difference in physical geography affects the peoples of the countries.

FOREIGN TRADE OF HOLLAND

(Average of recent years)

[Values in millions of £]

IMPORTS, 204: including Cereals and Flour, 22; Textiles, 9; Wood, 9; Iron and Steel Goods, 8; Oil Seeds, 5; Coal, 4.

EXPORTS, 145: including Butter, 6; Cheese, 6; Margarine, 5.

FOREIGN TRADE OF BELGIUM

(Average of recent years)

[Values in millions of £]

IMPORTS, 153: including Grain, 21; Wool, 10; Uncut Diamonds, 8.

EXPORTS, 130: including Iron and Steel and Machinery, 17; Cotton Goods, 8; Cut Diamonds, 8.

Exercise 96. Construct diagrams showing the amount and nature of the foreign trade of the Low Countries as directed in Exercise 86. Compare and contrast the trade of the two countries and suggest reasons for the differences you observe.

CHIEF TOWNS. *(Populations in 1925)*

In Holland:	Amsterdam	...	...	720,000 persons.
	Rotterdam	...	...	550,000 "
	The Hague	...	...	400,000 "
In Belgium:	Brussels	...	...	800,000 "
	Antwerp	...	...	300,000 "

Exercise 97. Draw diagrams to represent the sizes and occupations of these centres as directed in Exercise 87. Taking the two countries together, compare the number of large towns in the Low Countries with the number in France and with the number in Germany, taking into account the size of the countries. Try to account for the results you obtain, considering the proportion of highland and lowland, the position for trade, and the amount of coal produced. (See table on Page 78.)

Exercise 98. Calculate the average number of persons to the square mile in the Low Countries, the United Kingdom, France, and Germany respectively.

Scandinavia

AREAS AND POPULATIONS (*in 1920*)

	<i>Norway</i>	<i>Sweden</i>
Square miles	125,000	170,000
Persons	2,600,000	5,900,000

Exercise 99. Construct diagrams showing the areas, populations, and densities of populations of the two countries as directed in Exercise 80.

Calculate the average number of persons to the square mile, taking the peninsula as a whole. Contrast this result with those obtained in Exercise 98, and suggest the reasons for the contrast.

Exercise 100. Examine an orographical map of Scandinavia and compare and contrast the two countries in each of the following respects: coast, position, area and situation of highlands and lowlands, rivers and lakes. In each case show how the difference in physical geography affects the work of the peoples of the countries.

MEAN MONTHLY RAINFALL. (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Bergen	5.9	6.5	3.5	3.4	3.4	4.3
Stockholm	0.8	0.7	0.8	0.9	1.4	1.7
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bergen	5.1	7.2	8.1	8.7	6.7	8.0
Stockholm	2.3	2.4	1.8	2.0	1.4	1.1

MEAN MONTHLY TEMPERATURE (°F.)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Bergen	32.4	31.9	35.7	41.0	49.2	56.0
Stockholm	26.7	25.7	29.0	37.7	47.2	57.3
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.
Bergen	58.2	57.5	53.8	45.5	38.2	35.7
Stockholm	61.8	59.5	52.7	43.2	34.7	28.3

Exercise 101. Draw diagrams showing the mean monthly rainfall and temperature at Bergen and Stockholm.

Describe the climatic differences, and account for them as thoroughly as possible. (As before, study the positions of the places and observe the directions of the prevailing winds.)

FOREIGN TRADE OF NORWAY

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 73: including Breadstuffs, 10; Ships, Vehicles, and Machinery, 10; Textile Manufactures, 7; Groceries, 6.

EXPORTS, 50: including Wood Pulp and Paper, 16; Fish, 8; Timber, 3.

FOREIGN TRADE OF SWEDEN

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 80: including Groceries, 8; Oils, Tallow, and Tar, 8; Textile Raw Materials, 7; Textile Manufactures, 7; Corn and Flour, 6.

EXPORTS, 75 : including Wood Pulp and Paper, 21 ; Timber and other Wood Products, 14.

Exercise 102. Construct diagrams showing the nature and amount of the foreign trade of Scandinavia, as directed above. Write explanatory comments upon the trade of the two countries.

CHIEF TOWNS. (*Populations in 1920*)

In Norway : Oslo 260,000 persons.
In Sweden : Stockholm 420,000 „

Exercise 103. Draw diagrams to represent the size and occupation of these centres, as directed above.

Russia

AREA AND POPULATION (*in 1925*)

Area 8,186,000 square miles.
Population 140,000,000 persons.

Exercise 104. Construct a diagram showing the area, population, and density of population, as directed in Exercise 80. What countries of Europe would have to be added to the United Kingdom to obtain a population approximately equal to that of Russia?

MEAN MONTHLY TEMPERATURES AT MOSCOW (°F.)

(*Height above sea 558 feet*)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
12.2	14.7	23.3	38.2	53.7	59.3	65.5	60.2	50.7	38.5	27.7	17.2

Exercise 105. Construct a diagram to show these temperature conditions. Contrast them with those of Britain, and account for the differences.

In what ways do you think the temperature of the west of Russia differs from that of the east, and that of the north from that of the south? Give reasons for your suggestions.

MEAN MONTHLY RAINFALL AT MOSCOW. (*Inches*)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.1	0.9	0.9	1.5	1.9	2.0	2.8	2.9	2.2	1.4	1.6	1.5

Exercise 106. Construct a diagram to show these rainfall conditions. What is the total annual rainfall?

Contrast these conditions with those of Britain, and account for the differences.

What portions of Russia do you think have a rainfall considerably less than that of Moscow? Give reasons for your answer.

FOREIGN TRADE OF RUSSIA

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, **79**: including Machinery and Metal Goods, 16; Raw Cotton, 12; Chemicals, 5; Raw Wool, 4; Cotton Goods, 4.

EXPORTS, **70**: including Oil, 8; Wheat, 8; Leather and Hides, 7; Wood, 6; Barley, 5; Flax, 4; Butter, 3.

Exercise 107. Construct diagrams showing the amount and nature of the foreign trade of Russia, as directed above. What do the lists of imports and exports suggest as to the occupations of the people of Russia as compared with those of the United Kingdom? Account for the differences.

CHIEF TOWNS. (*Populations in 1925*)

Moscow	...	...	...	2,020,000 persons.
Leningrad	...	...	...	1,610,000 „
Kiev	...	...	...	490,000 „
Baku	...	...	...	450,000 „
Odessa	...	...	...	410,000 „
Kharkof	...	...	...	410,000 „
Tashkent	...	...	...	320,000 „
Rostov	...	...	...	300,000 „
Tiflis	...	...	...	280,000 „

Exercise 108. Draw a diagram showing the sizes and occupations of these centres, as directed above.

The Iberian Peninsula

AREAS AND POPULATIONS (*in 1920*)

	<i>Spain</i>	<i>Portugal</i>
Square miles	190,000	34,000
Persons	22,000,000	5,600,000

Exercise 109. Construct diagrams showing the areas, populations and density of population of the two countries, as directed in Exercise 80.

Compare the density of population of Spain with that of Portugal, and suggest reasons for the facts you observe.

Which parts of Spain are most densely populated? (Notice, among other facts, the situation of the towns.)

MEAN MONTHLY TEMPERATURES (°F.)

	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Madrid	2150	40.2	43.3	47.3	53.0	60.7	68.7
Lisbon	331	50.5	51.7	54.3	58.3	61.8	67.2
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Madrid	76.5	75.5	66.3	55.7	46.7	39.8	56.2
Lisbon	70.2	70.8	67.8	62.5	56.3	50.3	60.2

Exercise 110. Draw a diagram showing the temperature conditions at Madrid and Lisbon. Draw another diagram showing both sets of temperatures reduced to sea-level temperature. (Allow 1° F. for 300 feet of altitude.) State and account for the differences which still remain.

MEAN MONTHLY RAINFALL. (*Inches*)

	Jan.	Feb.	Mar.	Apr.	May	June
Madrid	1.3	1.1	1.8	1.9	1.8	1.2
Lisbon	3.7	3.3	3.8	2.8	2.1	0.5
	July	Aug.	Sept.	Oct.	Nov.	Dec.
Madrid	0.5	0.5	1.3	1.8	1.9	1.6
Lisbon	0.2	0.3	1.3	3.0	3.7	4.0

Exercise 111. Draw diagrams showing these rainfall conditions. State in what way the conditions at the two places are similar and in what way they are different.

Has any part of the British Isles a rainfall similar to that of Lisbon in regard to its distribution over the different parts of the year, i. e. in regard to its seasonal distribution?

Has any place in Europe, of which rainfall statistics have been given, a seasonal distribution of rain like that of Lisbon or Madrid?

FOREIGN TRADE OF SPAIN. (*Average of recent years*)
[*Values in millions of £*]

IMPORTS, 86: including Raw Cotton, 9; Iron and Steel and Machinery, 7; Timber, 6; Chemicals, 5.

EXPORTS, 64: including Fruits, 16; Wine, 6; Olive Oil, 4; Cork, 4; Ores, 4.

FOREIGN TRADE OF PORTUGAL. (*Average of recent years*)

IMPORTS, 23: including Cotton and Cotton Goods, 3; Iron and Steel and Machinery, 2.

EXPORTS, 7: including Wine, 3.

Exercise 112. Draw diagrams showing the amount and nature of the foreign trade of Spain and Portugal, as directed above, and write explanatory comments.

CHIEF TOWNS. (*Populations in 1920*)

In Spain :	Madrid	...	...	750,000 persons.
	Barcelona	...	...	710,000 "
	Valencia	...	...	250,000 "
In Portugal :	Lisbon	...	...	486,000 "

Exercise 113. Construct diagrams showing the size and occupations of these centres, as directed above. Can you account for the fact that the capital, Madrid, is not much larger than one of the other cities? In what other European countries is the same fact to be observed?

Italy

AREA AND POPULATION (*in 1915*)

Area	120,000 square miles.
Population	39,000,000 persons.

Exercise 114. Construct a diagram showing the area, population and density of population, as directed in Exercise 80. How does the density of population of Italy compare with that of the other states of Europe? Suggest reasons for the facts, taking into account the resources of Italy.

Exercise 115. Into what natural regions would you divide the whole of the political Kingdom of Italy? (Base your divisions upon the shape and relief of the land.) Make a sketch-map showing these divisions, and suggest an appropriate name for each. Which divisions are likely to be (*a*) the warmest, (*b*) the coldest, (*c*) the most populous, (*d*) the least populous?

RAINFALL AND TEMPERATURE AT ROME

(Height above sea-level 102 feet)

	Jan.	Feb.	Mar.	Apr.	May	June	
Temp. (°F.)	44.2	47.0	50.7	56.7	64.0	70.8	
Rain (inches)	2.9	2.3	2.5	2.3	2.2	1.5	
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Temp. (°F.)	76.3	75.5	70.0	61.5	52.2	45.7	59.5
Rain (inches)	0.6	1.1	2.7	4.1	4.4	3.3	29.9

Exercise 116. Construct diagrams showing these climatic conditions.

Compare the seasonal distribution of rain at Rome with that at Marseille, Madrid, and Lisbon, and taking these places as typical of the Mediterranean region, define what is meant by the 'Mediterranean type of rainfall'.

FOREIGN TRADE OF ITALY

*(Average of recent years)**[Values in millions of £]*

IMPORTS, 217: including Wheat, 31; Raw Cotton, 27; Coal and Coke, 14; Iron and Steel and Machinery, 12; Raw Wool, 8; Timber 6.

EXPORTS, 151: including Silk Thread and Goods, 24; Cotton Yarn and Goods, 23; Fruit, 11; Woollen Goods, 5; Motor Vehicles, 5; Cheese, 4.

Exercise 117. Draw diagrams showing the amount and nature of the foreign trade of Italy. What facts regarding the productions and occupations are suggested by the facts as to trade?

CHIEF TOWNS. *(Populations in 1924)*

	persons		persons
Milan ...	853,000	Palermo ...	405,000
Naples ...	784,000	Genoa ...	323,000
Rome ...	720,000	Florence ...	261,000
Turin ...	508,000	Catania ...	258,000

Exercise 118. Construct diagrams to show the size and occupations of the above centres, as directed above. What do you observe about the size of the capital of the Kingdom? Suggest causes which may have brought this about.

Union of South Africa

AREAS AND POPULATIONS (*in 1921*)

<i>Province</i>	<i>Area (square miles)</i>	<i>White Population</i>	<i>Coloured Population</i>
Cape of Good Hope	276,000	650,000	2,130,000
Natal	35,000	137,000	1,292,000
Transvaal	110,000	543,000	1,544,000
Orange Free State	50,000	189,000	440,000

Exercise 119. Construct a diagram showing the areas, total populations (white and coloured together), and densities of population in each province of the Union of South Africa. (Put one dot for every 100,000 people.)

In each respect compare the Union as a whole and each of its provinces with the British Isles. Account, as fully as you can, for the differences as regards the densities of population in the four provinces and the British Isles.

Exercise 120. Construct a similar diagram, but use red dots for the white population and black dots for the coloured population. Calculate what percentage of the total population in each province is white and coloured respectively.

MEAN MONTHLY TEMPERATURES (°F.)

Place	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Cape Town	40	69.3	69.7	68.0	63.1	58.9	55.5
Durban	260	76.6	76.6	76.0	72.4	67.8	64.9
Pretoria	4470	71.7	70.6	67.8	62.9	56.7	52.6

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Cape Town	54.8	55.6	57.0	60.7	64.2	67.3	62.0
Durban	64.6	66.0	67.6	69.7	72.8	74.8	70.8
Pretoria	51.7	56.7	63.4	67.6	69.2	71.1	63.5

Exercise 121. Construct a diagram showing these temperature conditions (see Fig. 17). State and suggest explanations for differences. How does each compare with the conditions at London?

MEAN MONTHLY RAINFALL (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Cape Town	0.7	0.6	0.9	1.8	3.9	4.4
Durban	4.6	4.5	4.6	3.0	2.0	0.7
Pretoria	5.5	3.9	3.5	1.1	0.6	0.2

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Cape Town	3.5	3.3	2.2	1.6	1.1	0.8	24.8
Durban	0.8	2.0	3.7	4.9	4.4	4.5	39.7
Pretoria	0.1	0.2	1.1	1.8	3.7	4.2	25.9

Exercise 122. Draw diagrams showing these rainfall conditions. State, and suggest reasons for, the differences. What type of climate has Cape Town? How do the agricultural productions of the districts round the three towns differ from one another, and how are they related to the climates of the three districts?

FOREIGN TRADE OF UNION OF SOUTH AFRICA

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 66: including Food and Drink, 8; Motor-cars and other Vehicles, 5; Apparel, 4; Hardware and Cutlery, 3; Machinery, 3.

EXPORTS, 83: including Gold, 39; Wool, 16; Diamonds, 8.

Exercise 123. Draw diagrams showing the nature and amount of this trade. In which provinces are the chief exports produced?

CHIEF TOWNS. (*Populations in 1921*)

Johannesburg	...	...	288,000	Durban	...	...	146,000
Cape Town	...	...	207,000	Pretoria	...	...	74,000

Exercise 124. Draw diagrams showing the sizes and occupations of these towns, and suggest reasons for their relative sizes.

Canada

AREA AND POPULATION (*in 1921*)

Area	3,654,000 square miles.
Population	8,788,000 persons.

Exercise 125. Construct a diagram showing the area, population and density of population of Canada, as directed above. In each respect compare Canada with the United Kingdom.

State which portions of Canada are most densely populated and which portions have practically no inhabitants?

Exercise 126. Take your map of Canada, and on tracing-paper copy the scale, and draw a rectangle to represent the British Isles according to this scale. (It might have a length representing 600 miles and a breadth representing 200 miles.) Place this upon the map of Canada and compare its size with that of portions of the Dominion, e.g. the separate provinces and Hudson Bay. State the results you obtain.

Exercise 127. Measure the length of the shortest railway line from Halifax to Vancouver, and calculate how long a train would take to complete the trans-continental journey if it travelled without stopping at the average rate of thirty miles an hour.

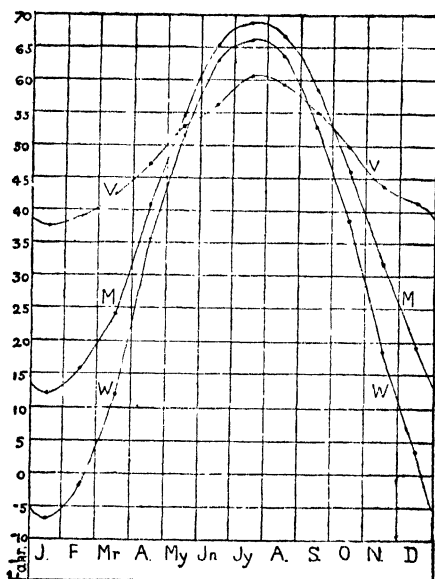


FIG. 17. Diagram showing the Mean Monthly Temperatures at Victoria (B.C.), Montreal, and Winnipeg.

MEAN MONTHLY TEMPERATURES (°F.)

Place	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Montreal	187	12.3	15.7	24.2	40.7	54.7	65.0
Winnipeg	764	-6.8	-1.8	12.2	35.5	51.7	62.8
Victoria (B. C.)	85	37.5	39.0	42.5	47.2	52.8	56.0
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Montreal	68.8	66.7	58.5	46.0	31.7	19.2	41.8
Winnipeg	66.0	63.7	52.8	38.3	18.3	3.7	33.0
Victoria (B. C.)	60.3	59.5	55.0	49.7	43.5	41.3	48.7

Exercise 128. Construct a diagram showing these temperature conditions. (See Fig. 17.) State and suggest explanations for the differences between the three places.

Have any parts of Europe temperature conditions similar to those of these three places? Give particulars.

MEAN MONTHLY RAINFALL. (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Montreal	3.8	3.2	3.4	2.4	3.2	2.8
Winnipeg	0.9	1.0	1.0	1.6	2.2	3.3
New Westminster	8.6	6.2	6.5	3.8	3.1	3.0

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Montreal	4.0	3.1	3.4	4.1	2.9	3.3	39.6
Winnipeg	3.1	2.7	2.0	1.7	1.1	0.9	21.5
New Westminster	2.2	2.3	3.4	5.5	8.2	9.1	61.9

Exercise 129. Draw diagrams showing these rainfall conditions. State and suggest reasons for the differences between these places.

Compare the position, temperature, and rainfall of the west of British Columbia and the west of the British Isles.

FOREIGN TRADE OF CANADA

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 184: including Iron Ore and Iron and Steel Goods, 26; Cotton and Cotton Goods, 17; Coal, 13; Wool and Woollen Goods, 11; Sugar, 8; Petroleum, 8.

EXPORTS, 260: including Wheat and Flour, 87; Wood Pulp and Paper, 32; Timber, 23; Iron and Iron Goods, 15; Other Metals, 13; Animals and Meat, 10; Butter and Cheese, 9.

Exercise 130. Draw diagrams showing the nature and amount of the trade of Canada, as directed above. In what parts of Canada are the exports produced?

CHIEF TOWNS. (*Populations in 1921*)

Montreal	...	...	770,000 persons.
Toronto	...	...	520,000 "
Winnipeg	...	...	170,000 "
Ottawa	...	...	110,000 "

Exercise 131. Draw diagrams showing the sizes and occupations of these centres, as directed above. Suggest reasons for (a) Montreal having become the largest city in Canada, and (b) the capital being relatively small.

IMMIGRATION. (*Average of recent years*)

Total 120,000 persons.

Including from England and Wales	...	...	29,000 persons.
United States	...	...	18,000 „
Scotland	...	...	17,000 „
Ireland	...	...	8,000 „
Russia	...	...	7,000 „
Germany	...	...	4,000 „

Exercise 132. Construct a diagram showing graphically the facts as to the immigration into Canada. What relation does the immigration bear to the total population?

United States

AREAS AND POPULATION (*in 1926*)

(Excluding Alaska and Hawaii)

Area 2,970,000 square miles.

Population 117,000,000 persons.

[*Alaska* :—

Area 590,000 square miles.

Population 70,000 persons.]

Exercise 133. Draw two rectangles with one side common to both to show the areas of the United States and Alaska, and show also the population and density of population in the United States by the method described in Exercise 80.

In each respect compare the United States with

Canada. Which of the larger countries of Europe would have to be added to make up a total area equal to that of the United States? Calculate the total population of these countries and compare it with that of the United States.

Exercise 134. Examine a map showing the relief of the country, and state the position and the relative extent of (*a*) the highlands, (*b*) the lowlands. Describe also the position of (*c*) the great mountain chains and (*d*) the easiest passages between or across the highland regions.

MEAN MONTHLY TEMPERATURES (°F.)

Place	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Washington	112	33.3	35.7	41.3	53.0	63.8	73.2
St. Louis	568	30.5	35.0	43.2	56.2	65.8	75.2
San Francisco	154	50.2	51.7	53.7	54.7	56.7	58.5
New Orleans	20	53.8	58.2	62.0	69.0	74.7	80.2

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Washington	76.8	74.7	67.8	56.2	44.5	36.2	54.7
St. Louis	78.8	76.8	69.5	57.5	43.5	35.7	55.5
San Francisco	58.3	58.7	60.5	59.3	56.3	51.5	55.7
New Orleans	82.2	81.5	78.2	69.8	60.7	55.5	68.7

Exercise 135. Construct a diagram showing these temperature conditions. (The lines relating to Washington and New Orleans may be of the same colour.) Contrast and account for the differences between the three places which are in about the same latitude.

What similarities and what dissimilarities are there between these places and the Canadian places studied above?

How do the conditions at New Orleans differ from those of all the other places for which statistics have been given? Suggest the reasons.

MEAN MONTHLY RAINFALL. (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Washington	3·4	3·1	3·9	3·4	4·1	3·9
St. Louis	2·2	2·7	3·4	3·7	4·7	5·0
San Francisco	5·0	3·7	3·1	1·9	0·7	0·1
New Orleans	5·1	4·4	5·3	5·2	4·8	6·7
Denver	0·6	0·5	1·0	2·0	2·7	1·3

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Washington	4·5	4·0	3·5	3·3	2·7	3·1	42·9
St. Louis	3·8	3·5	3·1	2·8	3·1	2·8	40·8
San Francisco	0·0	0·0	0·2	0·9	2·8	5·2	23·6
New Orleans	6·4	6·0	4·6	3·3	4·1	4·4	60·3
Denver	1·7	1·4	0·9	0·9	0·7	0·6	14·3

Exercise 136. Draw diagrams showing these rainfall conditions. State and suggest reasons for the chief differences between the places.

Why may the rainfall at San Francisco be described as of the Mediterranean type? Why does it have this type of rainfall?

PRODUCTION OF COAL
(*Average of recent years*)

United States	...	...	560 million tons.
British Isles	...	...	242 " "
Germany	...	...	200 " "
France	...	...	52 " "
Japan	...	...	30 " "
Poland	...	...	30 " "
Belgium	...	...	25 " "

Note.—In the case of Germany about half the production, judged by weight, is of lignite; the figure above is obtained by reckoning the lignite as having half the fuel value of coal.

Exercise 137. Construct a series of rectangles showing the relative amounts of coal produced by these countries, and print the name of each country in the appropriate rectangle. From what parts of the United States is coal produced?

PRODUCTION OF STEEL

(Average of recent years)

United States	...	...	46 million tons.
Germany	...	...	14 " "
British Isles	...	...	9 " "
France	...	...	8 " "
Belgium	...	...	3 " "
Japan	...	...	2 " "

Exercise 138. Show these facts by a graphic method, as suggested in the preceding exercise.

Examine this and the preceding table, and say whether they seem to be connected. What do you think are the reasons for the relative amounts of steel production?

PRODUCTION OF WHEAT

(Average of recent years)

United States	...	...	799 million bushels.
Russia	...	...	638 " "
Canada	...	...	406 " "
India...	...	..	324 " "
France	...	...	280 " "
Argentina	...	...	218 " "

Exercise 139. Show these facts by a similar graphic method. Which of these countries export wheat? To which countries of the world is the wheat sent?

PRODUCTION OF COTTON

(Average of recent years)

United States	...	...	16 million bales of 500 lb.
India	...	...	6 " "
Egypt	...	...	1½ " "

Exercise 140. Construct a diagram to show graphically the sources of raw cotton. What proportion of the total amount is grown in the United States?

To what extent do these countries manufacture the cotton? What advantages and disadvantages have they in respect of manufacturing?

FOREIGN TRADE OF THE UNITED STATES

(Average of recent years)

[Values in millions of £]

IMPORTS, 890: including Rubber, 181; Silk and Silk Goods, 90; Coffee, 63; Paper and Paper Goods, 48; Sugar, 43; Wool and Woollen Goods, 38; Furs, 22.

EXPORTS, 950: including Cotton and Cotton Goods, 230; Iron and Steel Goods, 110; Petroleum, 93; Motor-cars, 66; Grain and Flour, 52; Tobacco, 36.

Exercise 141. Construct diagrams showing the amount and nature of the foreign trade of the United States, as directed above.

On a sketch-map of the United States mark the places where the exports are produced. Also mark the chief coal-fields. Why is coal not among the exports?

CHIEF TOWNS. *(Populations in 1920)*

New York ...	5,620,000	Washington ...	440,000
Chicago ...	2,700,000	Newark ...	410,000
Philadelphia ...	1,820,000	Cincinnati ...	400,000
Detroit ...	990,000	New Orleans ...	390,000
Cleveland ...	800,000	Minneapolis ...	380,000
St. Louis ...	770,000	Kansas City ...	320,000
Boston ...	750,000	Seattle ...	320,000
Baltimore ...	730,000	Indianapolis ...	310,000
Pittsburgh ...	590,000	Jersey City ...	300,000
Los Angeles ...	580,000	Rochester ...	300,000
Buffalo ...	510,000	Portland, Ore. ...	260,000
San Francisco ...	510,000	Denver ...	260,000
Milwaukee... ..	460,000		

Exercise 142. Draw diagrams showing the sizes and occupations of these centres, as directed above.

Arrange the centres in three classes: Coastal cities; River cities; Lake cities. Find the average population of the cities in each class.

Make sketch-maps of the positions of the four chief cities, showing the lines of traffic which converge upon them.

IMMIGRATION. (*Average of recent years*)

Total 300,000 persons.

Including from	British Isles	...	...	...	52,000 persons.
	Germany	...	...	...	48,000 "
	Norway, Sweden, } and Denmark }	...	...	...	17,000 "
	Italy	...	...	...	7,000 "
	France	...	...	...	4,000 "
	Russia	...	...	...	2,000 "

Exercise 143. Construct a diagram showing the immigration into the United States, adopting the same method and scales as used in Exercise 132.

Compare and contrast the facts as to the immigration into Canada and the United States respectively, and, where possible, suggest reasons for the similarities and differences.

India

AREA AND POPULATION (*in 1921*)

	<i>Indian Empire</i>	<i>Ceylon</i>
Square miles	1,800,000	25,000
Persons	319,000,000	4,500,000

Exercise 144. Construct diagrams showing the areas, populations and densities of populations, according to the directions in Exercise 80.

Contrast the British Isles and India in each respect.

What European countries have a density of population nearly equal to India and Ceylon respectively?

CHIEF RELIGIONS OF INDIA (*in 1921*)

Hindus	217,000,000 persons.
Muhammadans	69,000,000 "
Buddhists	11,000,000 "
Animistic (Spirit worshippers) ...	10,000,000 "
Christians	5,000,000 "

Exercise 145. Describe a method to show graphically the relative importance of these religions. What proportion of the total population of 319,000,000 persons is included under each heading?

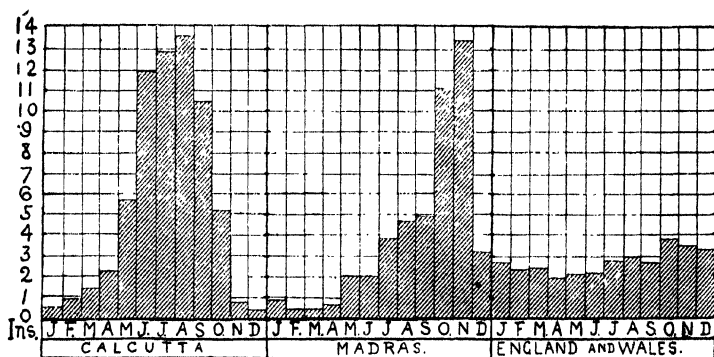


FIG. 18. Diagrams showing Mean Monthly Rainfalls at Calcutta and Madras, contrasted with the average of England and Wales.

MEAN MONTHLY TEMPERATURES (° F.)

Place	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Calcutta	23	66.2	70.7	80.0	85.5	85.2	85.0
Multan	420	56.3	59.5	72.1	82.7	90.3	94.5
Madras	23	75.5	77.2	80.8	84.7	87.3	87.3
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Calcutta	83.2	82.6	82.6	80.5	72.9	66.1	78.4
Multan	93.1	91.1	88.5	79.9	67.8	58.6	77.9
Madras	85.3	84.2	83.8	81.2	78.2	76.0	81.8

Exercise 146. Draw diagrams showing these temperature conditions. Which station has the most equable climate and which the most extreme? Account for these facts.

Suggest an explanation for the fact that the maximum temperature at Calcutta occurs in April.

MEAN MONTHLY RAINFALL. (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June	
Calcutta	0.4	0.9	1.3	2.2	5.7	11.9	
Multan	0.5	0.4	0.4	0.1	0.4	0.6	
Madras	0.8	0.3	0.4	0.6	2.0	2.0	
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Calcutta	12.8	13.5	10.3	5.1	0.7	0.3	65.1
Multan	2.9	1.6	0.4	0.0	0.1	0.2	7.6
Madras	3.8	4.6	4.8	11.0	13.3	3.2	46.8

Exercise 147. Draw diagrams showing these rainfall conditions. (See Fig. 18).

Compare the rainfall at Calcutta with that at (a) Multan, and (b) Madras, and account for the differences.

FOREIGN TRADE OF INDIA

(*Average of recent years*)

[*Values in millions of £*]

IMPORTS, 169: including Cotton Goods, 47; Metals and Metal Goods, 18; Sugar, 11; Machinery, 11; Oils 8.

EXPORTS, 275: including Cotton (Raw), 68; Jute (Goods), 42; Rice, 29; Jute (Raw), 27; Oil and Oil Seeds, 22; Tea, 20; Cotton (Yarn and Goods), 7.

[India also imports and exports much gold and silver bullion; the average net import of bullion during this period was worth more than £46,000,000.]

[Ceylon exported tea to the value of £13,000,000.]

Exercise 148. Show the amount and nature of the foreign trade of India, as directed above. Mark on

a sketch-map the regions from which the exports are obtained, and put arrows from each to the ports whence the commodities are likely to be exported.

CHIEF TOWNS. (*Populations in 1921*)

Bombay	1,175,000 persons.
Calcutta	1,132,000 „
Madras	526,000 „
Haidarabad	404,000 „
Rangoon	340,000 „
Delhi	304,000 „
Lucknow	280,000 „

Exercise 149. Construct diagrams showing the sizes and occupations of these centres. Which cities of Britain are most nearly equal to these in size?

China

AREA AND POPULATION. (*Estimates*)

	<i>Area (sq. miles)</i>	<i>Population</i>
China Proper	1,530,000	400,000,000
Dependencies and Frontier Provinces :—		
Mongolia	1,360,000	2,000,000
Hsinchiang (Chinese Turkestan)	550,000	2,000,000
Tibet	460,000	2,000,000
Manchuria	360,000	20,000,000

Exercise 150. Construct a diagram showing the area, population, and density of population, as directed above.

Compare the sum of the areas and populations of all the countries of Europe of which statistics have been given with the area and population of China Proper. What country of Europe has a density of population most nearly equal to that of China Proper?

MEAN MONTHLY TEMPERATURE AND RAINFALL
AT SHANGHAI

(Height above sea-level 23 feet)

	Jan.	Feb.	Mar.	Apr.	May	June	
Temp. (°F.)	37.0	39.2	46.0	56.5	65.5	73.3	
Rain (inches)	2.0	2.4	3.3	3.5	3.6	6.8	
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Temp. (°F.)	80.7	80.2	72.8	63.2	51.8	41.8	59.0
Rain (inches)	4.7	6.1	4.9	3.2	1.9	1.1	43.5

Exercise 151. Construct diagrams showing the temperatures and rainfall at Shanghai. In what way do you think the climate of Hankau differs from that of Shanghai?

Compare the climate of Shanghai with that of New Orleans, and account for the similarities and differences you note.

FOREIGN TRADE OF CHINA

(Average of recent years)

[Values in millions of £]

IMPORTS, 175: including Cotton Goods, 24; Rice, 10; Machinery and Metals, 8; Cigarettes, 4; Fish, 4.

EXPORTS, 135: including Raw Silk, 23; Beans, 22; Oils (vegetable), 8; Raw Cotton, 6; Hides and Skins, 4; Silk Goods, 4; Tea, 4.

Exercise 152. Construct a diagram showing the amount and nature of the trade of China. How does China compare (a) with India in the export of tea, and (b) with France, Italy, and Japan in the export of silk and silk goods?

Japan (with Korea and Formosa)

AREA AND POPULATION (in 1925)

Area	260,000 square miles.
Population	83,000,000 persons.

Exercise 153. Construct diagrams showing the area, population and density of population of Japan. In each respect compare Japan with the United Kingdom and with China.

MEAN MONTHLY TEMPERATURE AT TOKYO (° F.)

(Height above sea-level, 69 feet)

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
36.7	38.2	44.5	54.3	61.7	69.0	76.3	77.7	71.7	60.0	49.7	41.2

Exercise 154. Draw a diagram showing the temperature conditions at Tokyo, and compare them with those at (a) London, (b) Washington, and account for the similarities and dissimilarities you note.

Why is Shanghai compared with New Orleans in Exercise 151, and Tokyo with Washington in this exercise?

MEAN MONTHLY RAINFALL. (*Inches*)

	Jan.	Feb.	Mar.	Apr.	May	June	
Tokyo	2.2	3.0	4.4	5.0	5.9	6.5	
Kanazawa	10.8	6.9	6.5	6.8	5.5	6.6	
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Tokyo	5.2	4.3	8.0	7.3	4.3	2.1	58.2
Kanazawa	8.1	5.9	8.3	8.1	11.0	14.7	99.2

[*Note.* Kanazawa is on the west coast of Japan, almost north-west of Tokyo.]

Exercise 155. Draw diagrams showing these rainfall conditions, and account for the differences. Contrast the rainfall of Japan with that of the British Isles.

FOREIGN TRADE OF JAPAN

*(Average of recent years)**[Values in millions of £]*

IMPORTS, 240: including Raw Cotton, 76; Iron, 15; Metal Goods and Machinery, 15; Woollen Yarn and Goods, 12; Rice, 10; Wood, 10; Wool, 10.

EXPORTS, 205: including Raw Silk, 78; Cotton Yarn and Goods, 50; Silk Goods, 12; Sugar, 3; Paper and Paper Goods, 3.

Exercise 156. Construct diagrams showing the amount and nature of the foreign trade of Japan.

CHIEF TOWNS (*in 1925*)

Osaka	...	...	...	2,110,000 persons.
Tokyo	...	...	...	2,000,000 "
Nagoya	...	...	...	770,000 "
Kyoto	...	...	...	680,000 "
Kobé	...	...	...	640,000 "
Yokohama	...	...	...	410,000 "

Exercise 157. Construct diagrams showing the comparative size of these centres. Group these towns according to their situation, and describe as accurately as possible the situation of the groups.

Australian Commonwealth

AREAS AND POPULATIONS OF THE STATES (*in 1926*)

<i>State</i>	<i>Area (sq. miles)</i>	<i>Population</i>
New South Wales	310,000	2,320,000
Victoria	88,000	1,690,000
Queensland	670,000	880,000
South Australia	380,000	560,000
Western Australia	976,000	370,000
Tasmania	26,000	210,000
Northern Territory	524,000	4,000
Federal Territory	1,000	6,000
Total	2,975,000	6,040,000

Exercise 158. Construct diagrams showing the areas, populations and density of population in these states; according to the directions in Exercise 80.

Compare the area and population of the Commonwealth as a whole with those of the United States and of Canada.

In order to compare the densities of population in the individual states, make another set of diagrams using 1 square inch to 100,000 square miles as before, but putting one dot for every 100,000 inhabitants.

Suggest reasons for the differences between the states.

MEAN MONTHLY TEMPERATURES (° F.)

Place	Height in feet	Jan.	Feb.	Mar.	Apr.	May	June
Port Darwin	69	82.3	82.0	83.3	82.3	80.0	77.2
Brisbane	141	75.5	75.0	72.8	68.2	63.5	59.2
Adelaide	141	74.2	72.8	70.0	64.2	58.0	53.8
Place	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
Port Darwin	74.7	77.3	81.3	84.2	84.4	83.3	81.2
Brisbane	57.7	60.0	64.3	69.7	72.7	75.7	67.8
Adelaide	51.2	53.7	57.0	61.7	66.8	71.0	63.2

Exercise 159. Construct diagrams showing these temperature conditions. In what way do they differ from those previously studied?

Which part of Europe has a temperature most like that of Adelaide? Why are there no parts of Europe with temperatures similar to those of Port Darwin and Brisbane?

What place in the Northern Hemisphere have you studied which is almost the same distance north of the equator as Port Darwin is south of it? Compare the temperature at the two places.

MEAN MONTHLY RAINFALL. (*Inches*)

Place	Jan.	Feb.	Mar.	Apr.	May	June
Port Darwin	15.1	13.5	10.4	3.8	1.4	0.1
Sydney	3.7	5.5	5.4	5.7	5.1	5.4
Adelaide	0.7	0.7	1.0	1.8	3.0	3.0
Alice Springs	2.0	1.9	1.1	0.7	0.3	0.5
Perth	0.3	0.5	0.7	1.9	5.2	6.5
Hobart	1.5	1.5	1.5	1.8	1.8	2.0

Place	July	Aug.	Sept.	Oct.	Nov.	Dec.
Port Darwin	0.0	0.2	0.4	2.3	4.5	11.0
Sydney	4.3	2.8	3.2	2.9	3.1	2.6
Adelaide	2.8	2.5	1.9	1.7	1.1	0.9
Alice Springs	0.0	0.1	0.3	0.7	0.4	0.9
Perth	5.8	5.7	3.1	2.0	0.9	0.7
Hobart	2.2	1.8	2.1	2.0	2.9	1.7

Exercise 160. Construct diagrams showing these rainfall conditions, arranging them in the following groups:—(a) summer rainfall; (b) winter rainfall; (c) rainfall at all seasons.

Account for the relative amount and the seasonal distribution of the rain at each place.

Which part of Australia may be said to have a 'Mediterranean type of climate'? What similarities of position and climate are there between this region and the Mediterranean region?

PRODUCTION OF WOOL. (*Estimates*)

Australia	700 million pounds.
Europe (excluding British Isles)	600 „ „
South America	450 „ „
North America	300 „ „
New Zealand	200 „ „
South Africa	200 „ „
British Isles	100 „ „

Exercise 161. Construct a diagram showing the relative importance of the above regions in the production

of wool. Find out which portions of each region have the most sheep.

FOREIGN TRADE OF AUSTRALIA

(Average of recent years)

[Values in millions of £]

IMPORTS, 150: including Motor-cars, 12; Cotton and Linen Goods, 10; Silk Goods, 5; Rubber and Rubber Goods, 5.

EXPORTS, 150: including Wool, 63; Wheat, 17; Dairy Produce, 8; Hides and Skins, 8; Meat, 7; Flour, 7.

Exercise 162. Construct diagrams showing the amount and nature of the foreign trade of Australia.

CHIEF TOWNS. *(Populations in 1926)*

Sydney	...	...	...	1,040,000	persons.
Melbourne	...	...	...	920,000	"
Adelaide	...	...	...	310,000	"
Brisbane	...	...	...	270,000	"
Perth	...	...	...	180,000	"
Hobart	...	...	...	57,000	"

[The population of Hobart is given because it is the capital of Tasmania, and not because it is the sixth largest city of the Commonwealth.]

Exercise 163. Construct diagrams showing the size and occupations of these towns. What do you observe about the situation of the cities in this list which is typical of the distribution of the population as a whole? Account for this distribution of cities and people.

What proportion of the population of each of the states of Australia lives in the capital city? Compare these proportions with those which occur in the case of (a) England and Wales, (b) Canada.

COMPARATIVE DEVELOPMENTS IN BRITAIN AND OTHER COUNTRIES

Population

IT is important to know not only what are the conditions in a country at the present time, but also how these conditions are changing. For example, it is not sufficient to know what is the population of a country ; one needs to know whether that population is decreasing or increasing, and also whether the change is rapid or slow.

The table below gives the population of the British Isles as ascertained at each census from 1831 to 1921. It shows also the changes during the same period in the populations of the United States and Germany.

It is apparent that in each country the population is increasing, and for some purposes it is necessary to know in which country it is increasing most rapidly. That can be ascertained by comparing the figures, and it then appears that while during the ten years before the war of 1914-18 the British Isles had an increase of 4,000,000, the United States had an increase of 16,000,000, and Germany an increase of 9,000,000. (The figures for the last decade have been exceptionally changed by the war.)

All these facts and many others can be seen at a glance and compared very easily if they are expressed in the form of a diagram as shown in Fig. 19. The population at the date of each census is shown by a cross at the proper height above the base line, which should always represent *O* on the vertical scale. The crosses

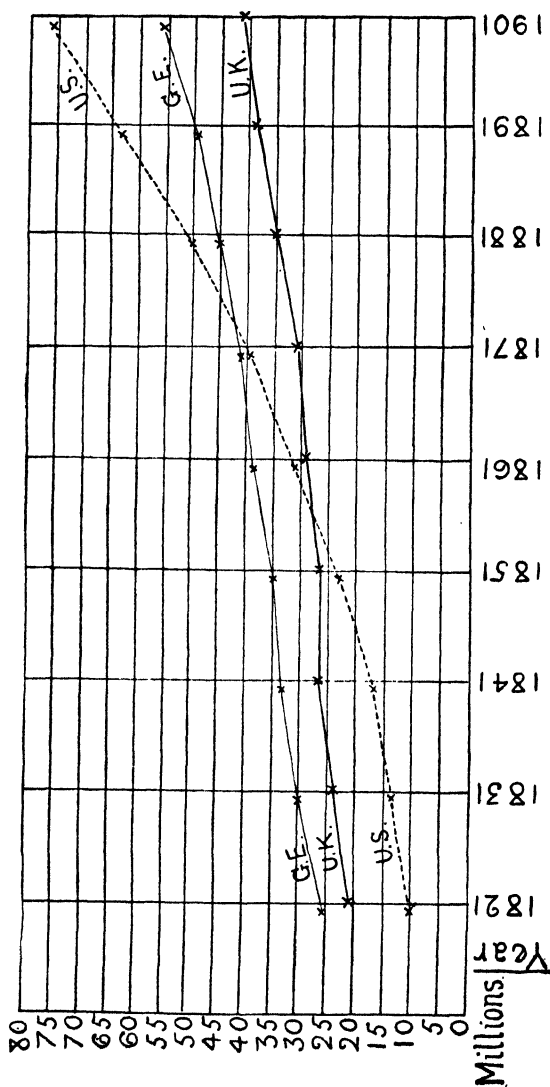


FIG. 19. Diagram showing Growth of Populations of the British Isles (U.K.), United States, and Germany. (Note. U.K. stands for 'United Kingdom of Great Britain and Ireland'; the name is no longer used since Southern Ireland has an independent government. Also Germany is no longer an 'Empire'.)

may be joined by lines, which help the eye in estimating changes. If two or three sets of changes are shown on the same diagram it is very desirable to use different coloured inks.

If the lines joining the crosses are taken to represent the population between the census years, the probable number of people can be estimated for any intervening year, and so the figure of the British Isles at any time can be compared with that of the United States, although the census is not taken in the same year in the two countries. Observe that the *rate* of increase is shown by the *steepness of the slope* of the lines.

CHANGES IN POPULATION

Numbers, in millions, at successive censuses

<i>British Isles</i>		<i>United States</i>		<i>Germany</i>	
<i>Date</i>	<i>Population</i>	<i>Date</i>	<i>Population</i>	<i>Date</i>	<i>Population</i>
1831	24	1830	13	1830	30
1841	27	1840	17	1840	33
1851	27	1850	23	1850	35
1861	29	1860	31	1860	38
1871	31	1870	39	1870	41
1881	35	1880	50	1880	45
1891	38	1890	63	1890	49
1901	41	1900	76	1900	56
1911	45	1910	92	1910	65
1921	47	1920	106	1920	60

Exercise 164. Re-draw Fig. 19 on a larger scale, using the figures in the above table. From an inspection of your diagram answer the following questions regarding the population of the British Isles :—

1. How much has it increased during the period ?

2. Has it increased at the same rate during the whole period?

3. During which years was the increase least?

Exercise 165. From an inspection of the diagram, answer the following questions:—

1. Arrange the countries according to the number of the inhabitants in 1831, 1861, and 1891 respectively.

2. Which country has increased most during the whole period, and which has increased least?

3. At what period (before the war) did this difference in the *rate* of increase become marked?

4. About what dates were (a) the population of the British Isles and United States equal, (b) the population of United States and Germany equal?

5. What influences does the war of 1914–18 appear to have had on these populations? How were the conditions affected in each case?

CHANGES IN POPULATION

Numbers, in millions, at successive censuses

<i>Year</i>	<i>England and Wales</i>	<i>Scotland</i>	<i>Ireland</i>	<i>Dominion of Canada</i>	<i>Australian Commonwealth</i>
1861	20.1	3.1	5.8	3.1	1.2
1871	22.7	3.4	5.4	3.6	1.7
1881	26.0	3.7	5.2	4.3	2.3
1891	29.0	4.0	4.7	4.8	3.2
1901	32.5	4.5	4.5	5.4	3.8
1911	36.0	4.7	4.4	7.2	4.6
1921	37.9	4.9	4.4	8.8	5.4

Exercise 166. Show the changes in the populations of Scotland, Ireland, Canada, and Australia by a diagram similar to that in Fig. 19. The vertical scale should be several times as great as before, because the populations to be shown are much smaller; the top of the diagram should indicate a population of nine millions. (As the lines

showing the growth in Canada and Australia are not close together, they may both be marked in the same colour, but the lines showing the growth in Scotland and in Ireland should be in different colours.)

Exercise 167. From an inspection of your diagram and the above table answer the following questions:—

1. The British Isles as a whole shows an increase of population; which portion of the Kingdom has contributed most to this increase and which portion has contributed least?
2. Bearing in mind that the rate of increase is shown by the steepness of the lines, state whether the population of Canada or that of Australia has increased more quickly during the period taken as a whole.
3. Does your diagram enable you to say what will be the population of each or any part of the Empire in 10 years' time?

Foreign Trade

The amount of the foreign trade of a country is some indication of its economic activity, but as the domestic trade, i.e. trade carried on within the country itself, is generally far greater than that carried on with other countries, the amount of the foreign trade alone must not be taken as a sure guide of the amount of work done. Yet the changes in the amount of foreign trade are very important, and a knowledge of them is necessary for the understanding of many great problems.

The tables below relate to the countries which have the greatest amount of foreign trade. The figures show the value of the 'special' imports, i.e. those which are imported for use in the country itself, and also the value

of the 'special' exports, i.e. those which have been produced in the particular country; the value of goods which merely pass through the country is excluded.

CHANGES IN FOREIGN TRADE OF BRITISH ISLES
(BEFORE THE WAR OF 1914-18)
Annual values in millions of £

<i>Year</i>	<i>Imports</i>	<i>Exports</i>	<i>Year</i>	<i>Imports</i>	<i>Exports</i>
1880	348	223	1897	391	234
1881	334	234	1898	410	233
1882	348	242	1899	420	264
1883	362	240	1900	460	291
1884	327	233	1901	454	280
1885	313	213	1902	462	283
1886	294	213	1903	473	291
1887	303	222	1904	481	301
1888	324	234	1905	487	330
1889	360	249	1906	523	376
1890	356	263	1907	554	426
1891	373	247	1908	513	377
1892	360	227	1909	533	378
1893	346	218	1910	574	430
1894	350	216	1911	577	454
1895	357	226	1912	632	487
1896	386	240	1913	659	525

Exercise 168. Draw a diagram showing in a graphic form the facts given in the above table (see Fig. 20). Answer the following questions regarding the observed changes:—

1. Were the imports and exports increasing on the whole?
2. Was the change regular or irregular in each case?
3. Were 'waves' of good trade to be observed? (Note particularly the exports.)
4. In regard to the exports, give the dates of three years with a specially great amount of trade which are followed by years with less trade.

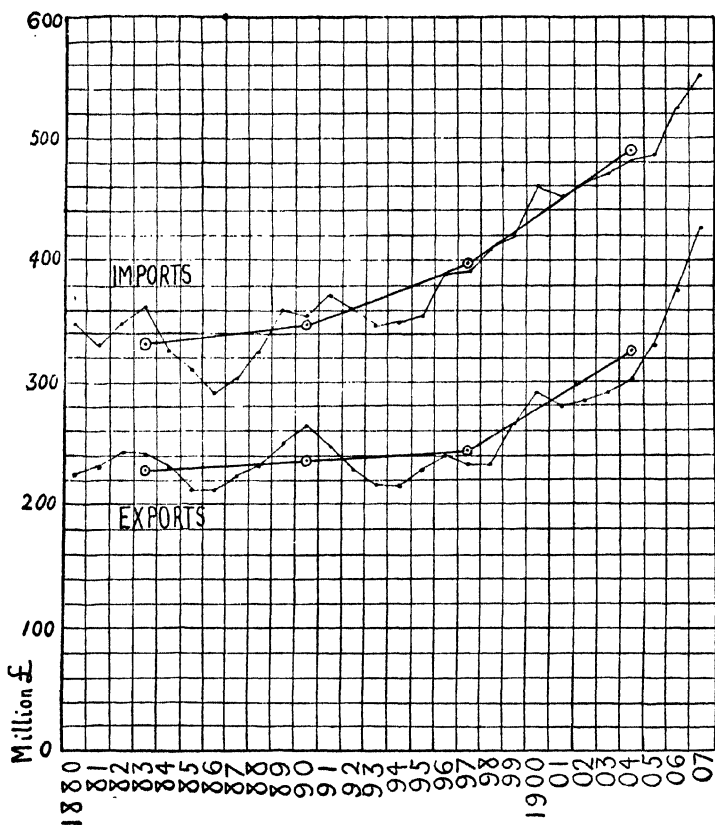


FIG. 20. Diagram showing Changes in the Foreign Trade of the British Isles.

5. Looking at both imports and exports, give the dates, as nearly as possible, of two periods of trade depression.

6. Would it be a good test of the general increase of trade to compare that of the year 1883 with that of 1893? Give reasons.

Exercise 169. Since the annual fluctuations of foreign trade are so great, an average taken for several years is very helpful in estimating the general movements. Calculate the average values for the four seven-year periods 1880-6, 1887-93, 1894-1900, and 1901-7, and the six-year period, 1908-13. The Great War began in 1914, and this year was therefore too exceptional to be included. Enter the results on your diagram by putting a dot surrounded by a ring at the proper height in the space for the middle year of each period (see Fig. 20). Connect these marks by lines of a different colour, and notice the differences between the lines showing the actual fluctuations and the lines showing the general movements. Answer the following questions:

1. In which portion of the whole period was the general increase most rapid and in which portion was it least rapid? (Notice the steepness of the slopes of the lines.)

2. Did the imports or the exports tend to increase most rapidly?

3. Do these facts show that the increase would have continued to be as rapid if the war had not occurred? Do the facts show that the increase would have been less rapid? Give the reasons for your answers.

FOREIGN TRADE PER HEAD OF POPULATION

Average values of Seven-Year Periods

<i>Period</i>	<i>Population Millions</i>	<i>Total Trade Million £</i>	<i>Amount per head £</i>
1880-1886	35.4	560	15.8
1887-1893	37.5	583	15.6
1894-1900	40.0	639	16.0
1901-1907	42.8	817	19.0
1908-1913	45.2	1024	22.6

The amount of trade alone does not tell us much about the prosperity of a country unless we know among how many people the trade is shared. The total trade of a country is due to the work of a very large number of people, and it is useful to know how much of it would fall to the share of each inhabitant if it were distributed equally; in this way the amount of trade per head of the population is found. It is obvious that if the total trade of a country increased very slowly while the population increased very rapidly, the amount per head would really decrease; in that case there might be a fall in general prosperity even while the total trade was slowly increasing. To find whether that is the case in Britain the above table was worked out from the figures given in the preceding tables.

Exercise 170. Construct a graph showing the changes in the amount of trade per head of the population. During this period Britain was spoken of as 'the workshop of the world'. What did the phrase mean? How did this work of Britain affect the foreign trade?

CHANGES IN PRE-WAR FOREIGN TRADE

Total annual values in millions of £

<i>Year</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1880	571	309	286
1881	568	314	297
1882	590	300	315
1883	602	314	327
1884	560	287	323
1885	526	268	290
1886	507	269	293
1887	525	287	313
1888	558	290	324
1889	609	305	359
1890	619	338	374
1891	620	355	366
1892	587	381	349
1893	564	350	353
1894	566	313	345
1895	583	314	372
1896	626	338	391
1897	625	370	416
1898	643	376	442
1899	684	391	484
1900	751	458	518
1901	734	470	493
1902	745	469	507
1903	764	500	542
1904	782	503	570
1905	817	537	632
1906	899	611	707
1907	980	685	761
1908	890	658	728
1909	811	606	786
1910	1004	653	848
1911	1031	708	911
1912	1119	765	1006
1913	1184	848	1030

The above table shows the changes in the value of the foreign trade, obtained by adding together the values of the special imports and the special exports, of the three most important industrial and commercial countries.

Exercise 171. Draw a graph showing these changes. Make the vertical scale 1 inch for £100,000,000 and the horizontal scale $\frac{1}{4}$ inch for one year. From an inspection of the diagram answer the following questions:—

1. Were the United States and Germany also subject to fluctuations of trade?

2. Did the periods of specially good trade come at the same time in each country?

3. Find years in which depression of trade seemed general.

Exercise 172. Calculate the average values of the trade of the United States and Germany taking the seven-year periods as before, and insert them in a table in the following form:—

CHANGES IN FOREIGN TRADE

Average values in millions of £

<i>Period</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1880-1886	560		
1887-1893	583		
1894-1900	639		
1901-1907	817		
1908-1913	1024		

Exercise 173. Draw a graph showing the facts given in the table, and state the conclusions you draw respecting the *comparative* growth of the foreign trade of the three countries.

Exercise 174. To make a more careful comparison of the business of the countries, the amount of trade per head for each period is required. Divide the total trade as stated in the table drawn up in Exercise 172 by the number of people as given below, and fill in the following table:—

FOREIGN TRADE PER HEAD OF POPULATION

*Average values in £**[Approximate populations, in millions, given in brackets.]*

<i>Period</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1880-1886	15.8 (35.4)	(54)	(46)
1887-1893	15.6 (37.5)	(63)	(49)
1894-1900	16.0 (40.0)	(72)	(54)
1901-1907	19.0 (42.8)	(82)	(59)
1908-1913	22.6 (45.2)	(92)	(65)

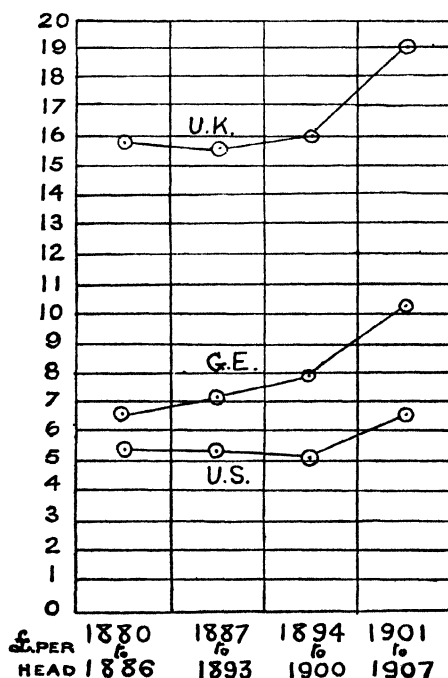


FIG. 21. Diagram showing Changes in the amount of Foreign Trade per head of the Population.

(Note. U.K. stands for British Isles and G.E. for old German Empire.)

Exercise 175. Draw a graph (see Fig. 21) based on the table showing the changes in the amount per head of the population in the three countries. From an inspection of the graph answer the following questions:—

1. Which country has had the steadiest increase in the amount of trade during the whole period?
2. Which country has had the least increase in the amount of trade per head of the population?
3. Compare the graphs showing the total amount of trade and the amount per head of the population, and specify three instances in which the total trade increased while the amount per head decreased. (Give the names of the countries, and the dates.)
4. State the relative conditions of the British Isles, the United States, and Germany as regards the trade per head of the population in the first years of the twentieth century.

Production

Another useful indication of the economic activity of manufacturing countries is the amount of coal produced. In studying the production of coal it must be remembered that although it is a sure guide to the amount of coal-mining it is not such a sure guide to the amount of manufacturing, e. g. in some cases coal is imported for this purpose, and in other cases coal may be exported instead of being used in the country. Further, the production of coal bears no relation to such economic activities as agriculture and fishing.

CHANGES IN PRODUCTION OF COAL

Annual production in million tons

<i>Year</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1870	112	30	35
1880	149	67	59
1890	185	142	89
1900	229	243	150
1910	265	446	180
1920	230	597	190
1925	248	531	200

Note. The fluctuating amounts in U.K. and U.S. for the last two years are due to post-war disturbances. Also the slower rate of increase in Germany is due to the loss of the Saar and part of the Upper Silesian coal-fields after the war.

Exercise 176. Draw a graph showing the changes in the production of coal as given in the above table. From an inspection of the graph answer the following questions :—

1. Compare the relative positions of the three countries at the beginning and at the end of the whole period.
2. By observing the steepness of the slopes find which country has had the most rapid increase and which country has had the slowest increase, taking the period as a whole.

 PRODUCTION OF COAL PER HEAD OF THE
POPULATION
Amount in tons

<i>Year</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1870	3.6	0.8	0.8
1880	4.3	1.3	1.3
1890	4.9	2.3	1.8
1900	5.6	3.2	2.7
1910	5.9	4.8	2.8
1920	5.0	5.6	3.1
1925	5.2	4.8	3.2

Exercise 177. 'The amount of production of coal per head of the population is a better indication of manufacturing activity than the amount of the total production of coal.' Show why this is so, and illustrate the answer by a comparison of the figures for the British Isles and the United States in the two tables.

Exercise 178. Draw a graph showing the change in the production of coal per head of the population of the three countries. From an inspection of the graph answer the following questions:—

1. What were the relative positions of the three countries in this respect at the beginning of the period?
2. In what ways did these positions change during the period?
3. What were the relative positions of the countries at the end of the period?

Note. When considering the production of coal as an indication of the amount of manufacturing in a country, a deduction must be made for coal exported for use elsewhere. In comparing the three countries in question, it must therefore be remembered that for many years over one-quarter of the British production is exported, while in the case of Germany, there is normally a considerable export and also, in the years just after the Great War much coal was sent to other countries as reparation for war damages. The following statistics are therefore given to serve as another basis for comparison of the relative importance of manufacturing activity.

CHANGES IN PRODUCTION OF PIG IRON

Annual production in millions of tons

<i>Year</i>	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1870	6.4	2.2	1.7
1880	6.9	3.1	2.5
1890	7.5	7.5	4.2
1900	8.6	14.2	7.5
1910	9.3	24.5	14.5
1920	8.0	36.4	6.5
1925	6.2	36.4	10.0

Since the smelting of iron ore and the production of pig iron is the process which is at the base of many branches of the iron and steel industries, the table on p. 105 is an index to a considerable proportion of the manufacturing of the three countries.

Exercise 179. Draw a graph from the figures in the table on p. 105, and state carefully *all* the conclusions you draw from an examination of the diagram.

PRODUCTION OF PIG IRON PER HEAD OF THE POPULATION

Year	<i>Average amount in cwt.</i>		
	<i>British Isles</i>	<i>United States</i>	<i>Germany</i>
1870	4.1	1.1	0.8
1880	3.9	1.2	1.1
1890	4.0	2.4	1.7
1900	4.2	3.7	2.7
1910	4.1	5.3	4.5
1920	3.4	6.9	2.2
1925	2.7	6.4	1.6

CHANGES IN PRODUCTION OF WHEAT

Year	<i>Amounts in millions of bushels</i>				
	<i>United States</i>	<i>Canada</i>	<i>France</i>	<i>India</i>	<i>Argentina</i>
1909	714	144	345	281	140
1910	616	129	250	355	146
1911	602	226	305	368	166
1912	708	220	325	363	198
1913	748	227	313	362	184
...	...	...	...	...	...
1919	948	189	179	275	168
1920	816	257	232	372	218
1921	798	295	317	248	156
1922	850	392	238	360	191
1923	781	465	270	365	195
1924	745	257	275	353	248
1925	653	403	324	318	191
1926	823	391	245	324	191
1927	871	444	278	333	220
1928	902	534	277	293	239

[Notes. 1. Russia has been omitted from this table because post-war disturbances made production vary very greatly and export almost entirely ceased.

2. The war years have been omitted because they were quite exceptional.

3. The figures for Argentina are those of the harvest of the preceding December which comes into the European market in the year stated.]

The changes in the production of wheat in the great wheat-fields of the world are of special importance to the people of Britain because most of the wheat they consume is obtained from abroad. The countries which at present produce the greatest amount are the United States, Russia, and Canada; Argentina exports much wheat, but France can send little abroad, and India usually has to import some for her own needs.

Exercise 180. Draw a graph showing the fluctuations in the production of these wheat-fields. Use red to show the production of the United States and Canada, black for that of France and Argentina, and a third colour for that of India.

Answer the following questions:—

1. Does the production of a single year give sufficient information on which to estimate the relative importance of the regions? Give instances to justify your answer.

2. Are good harvests in the United States usually accompanied by good harvests in (a) Canada, (b) Argentina? Again give the instances on which your answer is based.

3. Compare the fluctuation of the total production from all the regions with the fluctuation of the separate harvests.

Exercise 181. Make the necessary calculations and fill in the table below:—

INCREASES IN PRODUCTION OF WHEAT

Averages of five-year periods, in millions of bushels

<i>Year</i>	<i>United States</i>	<i>Canada</i>	<i>France</i>	<i>India</i>	<i>Argentina</i>
1909-1913					
1919-1923					
1924-1928					
Increases					

Devise a method, employing a series of rectangles, for showing as concisely as possible *all* the facts in the table.

Exercise 182. State the conclusions you draw from these facts regarding the present productivity and the growth of these wheat-fields.

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